than 10 ppm sulfur. Refiners producing only high sulfur distillate today should have an added advantage in meeting a 15 ppm sulfur cap for nonroad fuel over that for highway fuel. They would be able to design their hydrotreater from the ground up, while most refiners producing 15 ppm diesel fuel for highway use will be trying to utilize their existing 500 ppm hydrotreaters, which may not be designed to be revamped to produce 15 ppm fuel in the most efficient manner.

Based on our review of the limited catalyst performance data in the published literature and the one set of confidential data submitted, we believe that the projections of the more optimistic vendors are the most accurate for the 2010 timeframe given this additional leadtime. For example, the confidential commercial data indicated that five ppm sulfur levels could be achieved with two-stage hydrotreating at moderate hydrogen pressure despite the presence of a significant amount of light cycle oil (LCO). The key factor was the inclusion of a hydrogenation catalyst in the second stage, which saturated many of the poly-nuclear, aromatic rings in the diesel fuel, allowing the removal of sulfur from the most sterically hindered compounds. In addition, refiners that are able to defer production of 15 ppm highway diesel fuel through the purchase of credits, as well as refiners producing 15 ppm nonroad in 2010, would have the added benefit of being able to observe the operation of those hydrotreating units starting up in 2006. This should allow these refiners to be able to select from the best technologies which are employed in the highway program.

In addition, a number of alternative technologies are presently being developed which could produce 15 ppm fuel at lower cost. ConocoPhillips, for example, has developed a version of their S-Zorb technology for diesel fuel desulfurization. This technology utilizes a catalytic adsorbent to remove the sulfur atom from hydrocarbon molecules. It then sends the sulfur-laden catalyst to a separate reactor, where the sulfur is removed and the catalyst is restored. Unipure is developing a process which selectively oxidizes the sulfur contained in diesel fuel. This process have the advantage that the sulfur containing compounds which are most difficult to desulfurize via hydrotreating are quite easily desulfurized via oxidation. Finally, Linde has developed a method which greatly improves the concentration of hydrogen on hydrotreating catalysts. This process promises to greatly reduce the reactor volume necessary to produce 15 ppm diesel fuel.

These three new technologies are at various stages of development. This is discussed in more detail in the next section. Due to the projected ability of these technologies to reduce the cost of meeting a 15 ppm sulfur cap and the leadtime available between now and 2010, we project that 80% of the new volume of 15 ppm nonroad diesel fuel would be produced using advanced technologies.

7. Has Technology to Meet a 15 ppm Cap Been Commercially Demonstrated?

EPA just completed a review of refiners' progress in preparing to produce 15 ppm highway diesel fuel.[261] The information we obtained during that review confirm the projections we made in the HD 2007 program—refiners are technically capable of producing 15 ppm sulfur diesel fuel using extensions of conventional technology and, in fact, they are moving forward with their plans to comply with the program. Thus, we believe there are no technological hurdles to producing 15 ppm diesel fuel.

The European Union has also determined that diesel fuel can be desulfurized to meet a sulfur cap in the range of 10–15 ppm. Europe has established a 10 ppm sulfur cap on highway diesel fuel, effective in 2009, with plans underway for a 10 ppm sulfur cap for nonroad diesel fuel soon thereafter. As with our standards, Europe's 10 ppm cap applies throughout the distribution system. However, fuel tends to be transported much shorter distances in Europe. Therefore, we believe that both the 10 and 15 ppm sulfur caps will require refiners to meet the same 7–8 ppm sulfur target at the refinery gate. Given this, the European standard will require the same technology as that required in the U.S. Most European diesel fuel must meet a higher cetane number specification than U.S. diesel fuel, which causes it to be predominantly comprised of straight run material. This material is easier to desulfurize to sub-15 ppm levels using conventional hydtrotreating technology. In some European countries, nonroad diesel fuel is the same as heating oil and contains significant amounts of cracked material. Thus, on average, it should be easier for European refiners to meet a 10 ppm sulfur cap with their highway diesel fuel than in the U.S. As the 10 ppm cap is extended to nonroad diesel fuel, the stringency of the European standard will be much closer to that of a 15 ppm cap here in the U.S.

[261] *Ibid.*

We have met with a number of diesel fuel refiners to learn about their plans to produce 15 ppm highway diesel fuel by the June 2006 program compliance date. Since the 15 ppm diesel fuel sulfur standard was established based on the use of extensions of conventional diesel desulfurization technologies, diesel fuel refineries are well positioned to make firm plans for implementation by 2006. Our review has found that this is exactly what refiners are doing. We are very encouraged by the actions some refiners have already taken in terms of announcing specific plans for low sulfur diesel fuel production. It may still be early in the process, but virtually all refiners are already in the stage of planning their approach for compliance. Thus, the refining industry is where we anticipated it would be at this point in time. Moreover, some refining companies are ahead of schedule and will be capable of producing significant quantities of 15 ppm sulfur diesel fuel as early as next year. Thus, we expect that the capability of conventional hydrotreating to produce 15 ppm diesel fuel in refinery-scale quantities will be demonstrated in the U.S. by the end of 2003.

Phillips Petroleum is currently in the process of designing and constructing a commercial sized S-Zorb unit to produce sub-15 ppm diesel fuel at their Sweeney, Texas refinery. This plant is scheduled to begin commercial operation in 2004. This would provide refiners with roughly 3 years of operating data before they would have to decide which technology to use to meet the 15 ppm nonroad sulfur cap in 2010. This should be enough operating experience for most refiners to have sufficient confidence in this advanced process to include it in their options for 2010 compliance. Based on information received from Phillips Petroleum, we estimate that this technology could reduce the cost of meeting the 15 ppm cap for many refiners by 25 percent.

Linde has also developed a new approach for improving the contact between hydrogen, diesel fuel and conventional desulfurization catalysts. Linde projects that their Iso-Therming process could reduce the hydrotreater volume required to achieve sub-15 ppm sulfur levels by roughly a factor of 2. Linde has already built a commercial-sized demonstration unit at a refinery in New Mexico and has been operating the equipment since September 2002. Thus, refiners would have 4–5 years of operating data available on this process before they would have to decide which technology to use to meet the 15 ppm nonroad sulfur cap in 2010. This should be ample operating experience for essentially all refiners to include this process in their options for 2010. Based on information received from Linde, we estimate that this technology could reduce the cost of meeting the 15 ppm cap for many refiners by 40 percent.

Finally, Unipure Corporation is developing a desulfurization process which oxidizes the sulfur atom in diesel fuel molecules, facilitating its removal. This process operates at low temperatures and ambient pressure, so it avoids the need for costly, thick walled, pressure vessels and compressors. It also consumes no hydrogen. Thus, it could be particularly advantageous for refiners who lack an inexpensive supply of hydrogen (*e.g.*, isolated or smaller refineries who cannot construct a world scale hydrogen plant based on inexpensive natural gas). However, the oxidant is very powerful, so specialized, oxidation resistant materials are needed. Unipure has demonstrated its process at the pilot plant level, but has yet to build a commercial sized demonstration unit. However, time still remains for this to be done before refiners need to make final decisions for their 2010 compliance plans. Thus, while more uncertain than the other two advanced processes, the Unipure oxidation process could be selected by a number of refiners to meet the 2010 15 ppm cap. Based on inputs from Unipure, we estimate that their process could reduce the cost of meeting the 15 ppm cap for roughly one-fourth of all refineries by 25–35 percent.

The savings associated with each technology varies with the size, location and complexity of the refinery. However, on average the Linde process appears to have the potential reduce the cost of desulfurizing 500 ppm diesel fuel to 15 ppm by 35–40 percent. The savings associated with the Phillips and Unipure processes appear to be more refinery specific. For about 25 refineries, the Phillips process appears to have the potential to reduce these desulfurization costs by 20–40 percent. The primary advantage of the Unipure process is its lower capital costs. For about 30 refineries, the Unipure process appears to have the potential to reduce the capital investment related to produce 15 ppm fuel from 500 ppm diesel fuel by an average of 40 percent.

8. Availability of Leadtime To Meet the 2010 15 ppm Sulfur Cap

If we promulgate this proposal one year from today, this would provide refiners and importers with more than six years before they would have to begin complying with the 15 ppm cap for nonroad diesel fuel on June 1, 2010. Our leadtime analysis, which is presented in the draft RIA, projects that 30–39 months are typically needed to design and construct a diesel fuel hydrotreater.[262] Thus, refiners would have about 3 years before they would have to begin detailed design and construction. This would allow them time to observe the performance of the hydrotreaters being used to produce 15 ppm highway diesel fuel for at least one year. While not a full catalyst cycle, any unusual degradation in catalyst performance over time should be apparent within the first year. Thus, we project that the 2010 start date would allow refiners to be quite certain that the designs they select in mid-2007 will perform adequately in 2010.

In addition, we expect that most of the advanced technologies will be demonstrated on a commercial scale by the end of 2004. Thus, refiners would have at least two and a half years to observe the performance of these technologies before having to select a technology to meet the 2010 15 ppm cap. This should be more than adequate to fully access the costs and capabilities of these technologies for all but the most cautious refiners.

9. Feasibility of Distributing Nonroad, Locomotive and Marine Diesel Fuels That Meet the Proposed Sulfur Standards

There are two considerations with respect to the feasibility of distributing non-highway diesel fuels meeting the proposed sulfur standards. The first pertains to whether sulfur contamination can be adequately managed throughout the distribution system so that fuel delivered to the end-user does not exceed the specified maximum sulfur concentration. The second pertains to the physical limitations of the system to accommodate any additional segregation of product grades.

a. Limiting Sulfur Contamination

With respect to limiting sulfur contamination during distribution, the physical hardware and distribution practices for non-highway diesel fuel do not differ significantly from those for highway diesel fuel. Therefore, we do not anticipate any new issues with respect to limiting sulfur contamination during the distribution of non-highway fuel that would not have already been accounted for in distributing highway diesel fuel. Highway diesel fuel has been required to meet a 500 ppm sulfur standard since 1993. Thus, we expect that limiting contamination during the distribution of 500 ppm non-highway diesel engine fuel can be readily accomplished by industry.

In the highway diesel rule, EPA acknowledged that meeting a 15 ppm sulfur specification would pose a substantial new challenge to the distribution system. Refiners, pipelines and terminals would have to pay careful attention to and eliminate any potential sources of contamination in the system (*e.g.*, tank bottoms, deal legs in pipelines, leaking valves, interface cuts, etc.) In addition, bulk plant operators and delivery truck operators would have to carefully observe recommended industry practices to limit contamination, including practices as simple as cleaning out transfer hoses, proper sequencing of fuel deliveries, and parking on a level surface. Due to the need to prepare for compliance with the highway diesel program, we anticipate that issues related to limiting sulfur contamination during the distribution of 15 ppm nonroad diesel fuel will be resolved well in advance of the proposed 2010 implementation date for nonroad fuel. We are not aware of any additional issues that might be raised unique to nonroad fuel. If anything we anticipate limiting contamination will become easier as batch sizes are allowed to increase and potential sources of contamination decrease. We request comment on whether there are unique considerations regarding the transition to a 15 ppm standard for nonroad diesel fuel and what actions we should take beyond those that are already underway in preparation for the 15 ppm highway diesel program.

b. Potential Need for Additional Product Segregation

As discussed in sub-section B, we have designed the proposed program to minimize the need for additional product segregation and the associated feasibility and cost issues associated with it. This proposal would allow for the fungible distribution of 500 ppm highway and 500 ppm NRLM diesel fuel in 2007, and 15 ppm highway and 15 ppm nonroad diesel fuel in 2010, up until the point where NRLM or nonroad fuel must be dyed for IRS excise tax purposes. Heating oil would be required to be segregated as a separate pool beginning in 2007 through the use of a new marker, and locomotive and marine fuel by use of the same marker beginning in 2010. With this program design, we believe we have eliminated any potential feasibility issues associated with the need for product segregation. This is not to say that steps will not have to be taken. We have

[262] "Highway Diesel Progress Review," USEPA, EPA420-R-02-016, June 2002.

identified only a single instance where it seems likely that the adoption of this proposal would result in entities in the distribution system choosing to add new tankage due to new product segregation. Bulk plants in areas of the country where heating oil is expected to remain in the market will have to decide whether to add tankage to distribute both heating oil and 500 ppm NRLM fuel. In all other cases we anticipate segments of the distribution system will choose to avoid any fuel segregation costs by limiting the range of sulfur grades they choose to carry, just as they do today. Regardless, however, the costs and impacts of these choices are small. We request comment on this assessment. A more detailed explanation of this assessment can be found in Chapter 5.6 of the draft RIA.

G. What Are the Potential Impacts of the 15 ppm Sulfur Diesel Program on Lubricity and Other Fuel Properties?

1. What Is Lubricity and Why Might it Be a Concern?

Engine manufacturers and owner/operators depend on diesel fuel lubricity properties to lubricate and protect moving parts within fuel pumps and injection systems for reliable performance. Unit injector systems and in-line pumps, commonly used in diesel engines, are actuated by cams lubricated with crankcase oil, and have minimal sensitivity to fuel lubricity. However, rotary and distributor type pumps, commonly used in light and medium-duty diesel engines, are completely fuel lubricated, resulting in high sensitivity to fuel lubricity. The types of fuel pumps and injection systems used in nonroad diesel engines are the same as those used in highway diesel vehicles. Consequently, nonroad and highway diesel engines share the same need for adequate fuel lubricity to maintain fuel pump and injection system durability.

Diesel fuel lubricity concerns were first highlighted for private and commercial vehicles during the initial implementation of the Federal 500 ppm sulfur highway diesel program and the state of California's diesel program. The Department of Defense (DoD) also has a longstanding concern regarding the lubricity of distillate fuels used in its equipment as evidenced by the implementation of its own fuel lubricity improver performance specification in 1989.[263] The diesel fuel requirements in the state of California differed from the federal requirements by substantially restricting the content of diesel fuel requires more severe hydrotreating than reducing the sulfur content to meet a 500 ppm standard.[264] Consequently, concerns regarding diesel fuel lubricity have primarily been associated with California diesel fuel and some California refiners treat their diesel fuel with a lubricity additive as needed. Outside of California, hydrotreating to meet the current 500 ppm sulfur specification does not typically result in a substantial reduction of lubricity. Diesel fuels outside of California seldom require the use of a lubricity additive. Therefore, we anticipate only a marginal increase in the use of lubricity additives in NRLM diesel fuel meeting the proposed 500 ppm sulfur standard for 2007.[265] This proposal would require diesel fuel used in nonroad engines to meet a 15 ppm sulfur standard in 2010. Based on the following discussion, we believe that the increase in the use of lubricity additives in 15 ppm nonroad diesel fuel would be the same as that estimated for 15 ppm highway diesel fuel.

The state of California currently requires the same standards for diesel fuel used in nonroad equipment as in highway equipment. Outside of California, highway diesel fuel is often used in nonroad equipment when logistical constraints or market influences in the fuel distribution system limit the availability of high sulfur fuel. Thus, for nearly a decade nonroad equipment has been using federal 500 ppm sulfur diesel fuel and California diesel fuel, some of which may have been treated with lubricity additives. During this time, there has been no indication that the level of diesel lubricity needed for fuel used in nonroad engines differs substantially from the level needed for fuel used in highway diesel engines.

Blending small amounts of lubricity-enhancing additives increases the lubricity of poor-lubricity fuels to acceptable levels. These additives are available in today's market, are effective, and are in widespread use around the world. Among the available additives, biodiesel has been suggested as one potential means for increasing the lubricity of conventional diesel fuel. Indications are that low concentrations of biodiesel would be sufficient to raise the lubricity to acceptable levels.

Considerable research remains to be performed to better understand which fuel components are most responsible for lubricity. Consequently, it is unclear whether and to what degree the proposed sulfur standards for non-highway diesel engine fuel will impact fuel lubricity. Nevertheless, there is evidence that the typical process used to remove sulfur from diesel fuel—hydrotreating—can impact lubricity depending on the severity of the treatment process and characteristics of the crude. We expect that hydrotreating will be the predominant process used to reduce the sulfur content of non-highway diesel engine fuel to meet the 500 ppm sulfur standard during the first step of the proposed program. The highway diesel program projected that hydrotreating would be the process most frequently used to meet the 15 ppm sulfur standard for highway diesel fuel. The 2010 implementation date for the proposed 15 ppm standard for nonroad diesel fuel would allow the use of new technologies to remove sulfur from fuel.[266] These new technologies have less of a tendency to affect other fuel properties than does hydrotreating.

Based on our comparison of the blendstocks and processes used to manufacture non-highway diesel fuels, we believe that the potential decrease in the lubricity of these fuels from hydrotreating that might result from the proposed sulfur standards should be approximately the same as that experienced in desulfurizing highway diesel fuel.[267] To provide a conservative, high cost estimate, we assumed that the potential impact on fuel lubricity from the use of the new desulfurization processes would be the same as that experienced when hydrotreating diesel fuel to meet a 15 ppm sulfur standard. We request comment on the potential impact of these new desulfurization technologies on lubricity (as well as other fuel properties) that might help us to improve our estimate of the potential impacts of this proposal on fuel properties other than sulfur. Given that the requirements for fuel lubricity in highway and non-highway engines are the same, and the potential decrease in lubricity from desulfurization of non-highway diesel engine would be no greater than that experienced in desulfurizing highway diesel fuel, we

[263] DoD Performance Specification, Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble, , MIL-PRF–25017F, 10 November 1997, Superseding MIL-I–25017E, 15 June 1989.

[264] Chevron Products Diesel Fuel Technical Review provides a discussion of the impacts on fuel lubricity of current diesel fuel compositional requirements in California versus the rest of the nation. *http://www.chevron.com/prodserv/fuels/bulletin/diesel/l2%5F7%5F2%5Frf.htm.*

[265] The cost from the increased use of lubricity additives in 500 ppm NRLM diesel fuel in 2007 and in 15 ppm nonroad diesel fuel in 2010 is discussed in section V of today's preamble.

[266] *See* section IV.F for a discussion of which desulfurization processes we expect will be used to meet the 15 ppm standard for nonroad diesel fuel.

[267] *See* chapter 5 of the RIA for a discussion of the potential impacts on fuel lubricity of this proposal.

estimate that the potential need for lubricity additives in non-highway diesel engine fuel under this proposal would be the same as that for highway diesel fuel meeting the same sulfur standard.

2. A Voluntary Approach on Lubricity

In the United States, there is no government or industry standard for diesel fuel lubricity. Therefore, specifications for lubricity are determined by the market. Since the beginning of the 500 ppm sulfur highway diesel program in 1993, refiners, engine manufacturers, engine component manufacturers, and the military have been working with the American Society for Testing and Materials (ASTM) to develop protocols and standards for diesel fuel lubricity in its D–975 specifications for diesel fuel. ASTM is working towards a single lubricity specification that would be applicable to all diesel fuel used in any type of engine. Although ASTM has not yet adopted specific protocols and standards, refiners that supply the U.S. market have been treating diesel fuel with lubricity additives on a batch to batch basis, when poor lubricity fuel is expected. Other examples include the U.S. military, Sweden, and Canada. The U.S. military has found that the traditional corrosion inhibitor additives used in its fuels have been highly effective in reducing fuel system component wear. Since 1991, the use of lubricity additives in Sweden's 10 ppm sulfur Class I fuel and 50 ppm sulfur Class II fuel has resulted in acceptable equipment durability.[268] Since 1997, Canada has required that its 500 ppm sulfur diesel fuel not meeting a minimum lubricity be treated with lubricity additives.

The potential need for lubricity additives in diesel fuel meeting a 15 ppm sulfur specification was evaluated during the development of EPA's highway diesel rule. In response to the proposed highway diesel rule, all comments submitted regarding lubricity either stated or implied that the proposed sulfur standard of 15 ppm would likely cause the refined fuel to have lubricity characteristics that would be inadequate to protect fuel injection equipment, and that mitigation measures such as lubricity additives would be necessary. However, the commenters suggested varied approaches for addressing lubricity. For example, some suggested that we need to establish a lubricity requirement by regulation while others suggested that the current voluntary, market based system would be adequate. The Department of Defense recommended that we encourage the industry (ASTM) to adopt lubricity protocols and standards before the 2006 implementation date of the 15 ppm sulfur standard for highway diesel fuel.

The final highway diesel rule did not establish a lubricity standard for highway diesel fuel. We believe the issues related to the need for diesel lubricity in fuel used in non-highway diesel engines are substantially the same as those related to the need for diesel lubricity for highway engines. Consequently, we expect the same industry-based voluntary approach to ensuring adequate lubricity in non-highway diesel fuels that we recognized for highway diesel fuel. We believe the best approach is to allow the market to address the lubricity issue in the most economical manner, while avoiding an additional regulatory scheme. A voluntary approach should provide adequate customer protection from engine failures due to low lubricity, while providing the maximum flexibility for the industry. This approach would be a continuation of current industry practices for diesel fuel produced to meet the current federal and California 500 ppm sulfur highway diesel fuel specifications, and benefits from the considerable experience gained since 1993. It would also include any new specifications and test procedures that we expect would be adopted by the American Society for Testing and Materials (ASTM) regarding lubricity of NRLM diesel fuel quality.

Regardless, this is an issue that will be resolved to meet the demands of the highway diesel market, and whatever resolution is reached for highway diesel fuel could be applied to non-highway diesel engine fuel with sufficient advance notice. We are continuing to participate in the ASTM Diesel Fuel Lubricity Task Force[269] and will assist their efforts to finalize a lubricity standard in whatever means possible. We are hopeful that ASTM can reach a consensus early this summer at the next meeting of the ASTM's Lubricity Task Force. We request comment on what actio ns EPA should take to ensure adequate lubricity of non-highway diesel engine fuel beyond those already underway for highway diesel fuel.

3. What Other Impact Would Today's Actions Have on the Performance of Diesel and Other Fuels?

We do not expect that the proposed fuel program would have any negative impacts on the performance of diesel engines in the existing fleet which would use the fuels regulated today. In the early 1990's, California lowered the maximum allowable level of sulfur content of highway and nonroad diesel fuel to 500 ppm, and at the same time California significantly lowered the aromatic content of diesel fuel. California required a cap on total aromatics of 10 percent by volume, while the in-use average at the time was on the order of 35 percent. The lowering of the total aromatic content resulted in some problems with leaks from the fuel pump O-ring seals in some diesel engines due to a change specifically in the polynuclear aromatics content (PNA). In the process of meeting California's 10 percent total aromatic content requirement, the end result typically lowered PNA's from approximately 10–15 percent by volume to near-zero. In the early 1990's, some diesel engine manufacturers used a certain material (Nitrile) for O-rings in diesel fuel pumps. The Nitrile seals were found to be susceptible to leakage with the use of diesel fuel with very low PNA content. Normally, the PNA in the fuel penetrated the Nitrile material and cause it to swell, thereby providing a seal with the throttle shaft. When very low PNA fuel is used after conventional fuel has been used, the PNA already in the swelled O-ring would leach out into the very low PNA fuel. Subsequently, the Nitrile O-ring would shrink and pull away, thus causing leaks, or the stress on the O-ring during the leaching process would cause it to crack and leak. Not all 500 ppm sulfur fuels caused this problem, because the amount and type of aromatics varied, and the in-use seal problems were focused in California due to the 10 percent aromatic requirements and the resulting very low PNA content. This was not a wide-spread issue for the rest of the U.S. where highway diesel fuel also had a 500ppm sulfur cap because the federal requirements did not include a lower aromatic cap. While the process of lowering sulfur levels to 500ppm does lower PNA, it does not achieve the near-zero levels seen in California. Since the 1990's, diesel engine manufacturers have switched to alternative materials (such as Viton), which do not experience leakage. We believe that no issues with leaking fuel pump O-rings would occur with the changes in diesel fuel sulfur levels

[268] Letter from L. Erlandsson, MTC AB, to Michael P. Walsh, dated October 16, 2000. EPA air docket A–99–06, docket item IV–G–42.

[269] ASTM sub committee D02.E0.

contained in this proposal (both the 500 ppm requirement in 2008 and the 15 ppm requirement in 2010) because while we do believe PNA content will be reduced, we are not predicting it will achieve the near-zero level experienced in California.

We expect that this proposal would have no negative impacts on other fuels, such as jet fuel or heating oil. We do expect that the sulfur levels of heating oil would decrease because of this proposal. Beginning in mid-2007, we expect that controlling NRLM diesel fuel to 500 ppm would lead many pipelines to discontinue carrying high sulfur heating oil as a separate grade. In areas served by these pipelines, heating oil users would likely switch to 500 ppm diesel fuel. This would reduce emissions of sulfur dioxide and sulfate PM from furnaces and boilers fueled with heating oil. The primary exception to this would likely be the Northeast and some areas of the Pacific Northwest, where a distinct higher sulfur heating oil would still be distributed as a separate fuel. Also, we expect that a small volume of high sulfur distillate fuel would be created during distribution from the mixing of low sulfur diesel fuels and higher sulfur fuels, such as jet fuel in the pipeline interface. Such high sulfur distillate would likely be sold by the terminal as high sulfur heating oil or reprocessed by transmix processors.

H. Refinery Air Permitting

Prior to making diesel desulfurization changes, some refineries may be required to obtain a preconstruction permit, under the New Source Review (NSR) program, from the applicable state/local air pollution control agency.[270] We believe that the proposed program provides sufficient lead time for refiners to obtain any necessary NSR permits well in advance of the compliance date.

Given that today's diesel sulfur program would provide roughly three years of lead time before the 500 ppm standard would take effect, we believe refiners would have time to obtain any necessary preconstruction permits. Nevertheless, we believe it is reasonable to continue our efforts under the Tier 2 and highway diesel fuel programs, to help states in facilitating the issuance of permits under the NRLM diesel sulfur program. For example, the guidance on Best Available Control Technology (BACT) and Lowest Achievable Emission Rate (LAER) control technology that was developed for the gasoline sulfur program should have application for diesel desulfurization (highway and NRLM) projects as well. Similarly, we believe the concept of EPA permit teams for gasoline sulfur projects could readily be extended to permits related to diesel projects as well. These teams, as needed, would track the overall progress of permit issuance and would be available to assist state/local permitting authorities, refineries and the public upon request to resolve site-specific permitting questions. In addition, these teams would be available, as necessary, to assist in resolving case specific issues to ensure timely issuance of permits. Finally, to facilitate the processing of permits, we encourage refineries to begin discussions with permitting agencies and to submit permit applications as early as possible.

V. Program Costs and Benefits

In this section, we present the projected cost impacts and cost effectiveness of the proposed nonroad Tier 4 emission standards and low-sulfur fuel requirement. We also present a benefit-cost analysis and an economic impact analysis. The benefit-cost analysis explores the net yearly economic benefits to society of the reduction in mobile source emissions likely to be achieved by this rulemaking. The economic impact analysis explores how the costs of the rule will likely be shared across the manufacturers and users of the engines, equipment and fuel that would be affected by the standards.

The results detailed below show that this rule would be highly beneficial to society, with net present value benefits through 2030 of $550 billion, compared to a net present value of social cost of only about $16.5 billion (net present values in the year 2004). The impact of these costs on society should be minimal, with the prices of goods and services produced using equipment and fuel affected by the proposal being expected to increase about 0.02 percent.

Further information on these and other aspects of the economic impacts of our proposal are summarized in the following sections and are presented in more detail in the Draft RIA for this rulemaking. We invite the reader to comment on all aspects of these analyses, including our methodology and the assumptions and data that underlie our analysis.

A. Refining and Distribution Costs

As described above, the fuel-related requirements associated with this proposed rule would be implemented in two steps. Nonroad, locomotive and marine diesel fuel would be subject to a 500 ppm sulfur cap beginning June 1, 2007, while nonroad diesel fuel would be subject to a 15 ppm sulfur cap beginning June 1, 2010. Meeting these standards would generally require refiners adding hydrotreating equipment and possibly new or expanded hydrogen and sulfur plants in their refineries for desulfurizing their nonroad diesel fuel and dispensing of the removed sulfur. Using information provided by vendors of desulfurization equipment and through discussions with distributors of nonroad diesel fuel, we estimated the desulfurization and associated distribution and additive cost for complying with this two step desulfurization program. Except for the costs presented at the end of this section, the costs below reflect a fully phased in fuels program without the proposed small refiner exemption. Costs are in 2002 dollars. We request comment on the cost estimates presented below and the methodologies used to develop them. You can refer to the Draft RIA for details.

The cost to provide nonroad, locomotive and marine diesel fuel under the proposed fuel program is summarized in Table V–A–1 below. The costs shown (and all of the costs described in the rest of this section) only apply to the roughly 65 percent of current nonroad, locomotive and marine diesel fuel that contains more than 500 ppm sulfur (hereafter referred to as the affected volume). We estimate that the other 35 percent of this fuel is actually fuel certified to the highway diesel fuel standards and project that this will continue. Thus, the proposed fuel program would not affect this fuel and no additional costs would be incurred by its refiners or distributors. The costs and benefits of desulfurizing this highway fuel which spills over into the non-highway markets was already included in EPA's 2007 highway diesel fuel rule.

[270] Hydrotreating diesel fuel involves the use of process heaters, which have the potential to emit pollutants associated with combustion, such as NO_X, PM, CO and SO_3. In addition, reconfiguring refinery processes to add desulfurization equipment could increase fugitive VOC emissions. The emissions increases associated with diesel desulfurization would vary widely from refinery to refinery, depending on many source-specific factors, such as crude oil supply, refinery configuration, type of desulfurization technology, amount of diesel fuel produced, and type of fuel used to fire the process heaters.

TABLE V–A–1.—INCREASED COST OF PROVIDING NONROAD, LOCOMOTIVE AND MARINE DIESEL FUEL

	Cents per gallon of affected fuel			Affected fuel volume (million gallons/year) [a]
	Refining	Lubricity and distribution	Total	
Step One—500 ppm NRLM diesel fuel	2.2	0.3	2.5	9,504
Step Two—5 ppm Nonroad diesel fuel	4.4	0.4	4.8	7,803
Step Two—500 ppm Locomotive and Marine diesel fuel	2.2	[b] 0.2	2.4	4,093

Notes:
[a] 2008 for Step One (without consideration of small refiner provisions), 2015 for Step Two.
[b] 0.4 cent per gallon from mid-2010 to mid-2014 due to need for marker.

The majority of the fuel-related cost of the proposal is refining-related. These costs include required capital investments amortized at 7 percent per annum before taxes. The derivation of these costs is discussed in more detail below and in the Draft RIA. We request comment on the estimated cost of meeting the 15 ppm and 500 ppm sulfur caps.

We also project that the increased cost of refining and distributing 15 ppm and 500 ppm fuel would be substantially offset by reductions in maintenance costs. These savings would apply to all diesel engines in the field, not just new engines. Refer to section V. B for a more complete discussion on the projected maintenance savings associated with lower sulfur fuels.

1. Refining Costs

Our process for estimating the refining costs associated with the proposed fuel program consisted of four steps. One, we estimated the volume of 500 and 15 ppm nonroad, locomotive and marine diesel fuel which had to be produced in each PADD [271] in each phase of the program. This step utilized diesel fuel and heating oil use estimates from the Energy Information Administration's (EIA) Fuel Oil and Kerosene Survey for 2000, shipments of diesel fuel between PADDs, projected loss of 15 and 500 ppm volume due to contamination during distribution and small refiner provisions. This nonroad diesel fuel consumption in 2000 is lower than that inherent in the emission estimates described above, which are based directly on the results of EPA's NONROAD emission model. We are investigating ways to make the two estimates more consistent.

Growth in distillate fuel use off this year 2000 base was estimated using projections from EIA's Annual Energy Outlook, with one exception. This exception was that the growth in nonroad diesel fuel use was taken from EPA's NONROAD emission model (roughly three percent per year), as opposed to EIA's projected growth of roughly one percent per year. The higher growth rate is consistent with that inherent in the emission estimates described above.

Refinery production of low and high sulfur distillate fuel in the year 2000 was based on actual reports provided to EIA by all U.S. refiners and importers. Refinery production of low and high sulfur distillate fuel was assumed to grow at the same rate as consumption of the two types of fuel, respectively. These rates were roughly three percent and one and a half percent for low and high sulfur distillate fuel production, respectively. The specific volumes of highway, nonroad, locomotive, and marine diesel fuel by calendar year are presented in chapter 7 of the Draft RIA.

Two, we estimated the cost for each refinery to desulfurize its high sulfur fuel to 500 and 15 ppm. This was based on their historical production volume of high sulfur diesel fuel and estimates of the composition of this fuel (straight run, light cycle oil, etc.).[272] We also considered whether these refineries would be modifying or building hydrotreating capacity in order to meet the 15 ppm highway cap.

Three, we estimated which refineries would find it difficult to market all of their current high sulfur diesel fuel as heating oil, due to their location relative to major pipelines and the size of the heating oil market in their area. Those not located in major heating oil markets and not connected to pipelines serving these areas were projected to have to meet the 500 ppm cap in 2007.

Four, we determined the additional refineries which would produce 500 ppm and 15 ppm fuel to satisfy demand during each phase of the fuel program. Refineries projected to have the lowest compliance costs in each PADD were projected to produce the lower sulfur fuels until demand was met. PADD 3 refineries were allowed to ship low sulfur fuel to the Northeast, but no other inter-PADD transfers were assumed. Imports of 500 ppm highway diesel fuel were assumed to increase at the rate of highway diesel fuel consumption and be converted to 15 ppm diesel fuel, 80 percent in 2006 and 100 percent in 2010. Imports of high sulfur distillate fuel were assumed to increase at the rate of high sulfur distillate fuel consumption, but were assumed to remain entirely high sulfur heating oil even after today's NRLM fuel proposal. In other words, all 15 ppm and 500 ppm NRLM fuel produced under this proposal was assumed to be produced by domestic refineries. This assumption increased the projected costs of the proposal described above more than would have been the case had we assumed that domestic production and imports of high sulfur distillate fuel would each keep their respective shares of the NRLM diesel fuel and heating oil markets in response to this proposal. The relative costs of producing 15 ppm nonroad diesel fuel by domestic and overseas refiners is discussed further in section V.A.6. below.

With the onset of a 2007 500 ppm sulfur cap for nonroad, locomotive and marine diesel fuel, we project that the market for high sulfur diesel fuel and heating oil would become so small that high sulfur fuel would no longer be shipped through common carrier pipelines in most areas. The prime exception to this would be the Northeast, where the heating oil market is very large. Thus, refiners located in the Northeast and those along the major pipelines serving the Northeast, namely the Colonial and Plantation pipelines, could continue to produce high sulfur

[271] Petroleum Administrative for Defense Districts.

[272] The composition of nonroad diesel fuel in each PADD was based on a survey conducted by API and NPRA in 1996. Crude oils processed by domestic refiners have been becoming heavier over time, necessitating greater use of coking and hydrocracking to convert the heavy material into lighter, saleable products. Thus, the contributions of coker and hydrocracked distillate to the overall distillate pool are rising. Coker distillate is somewhat more difficult to desulfurize than average distillate, but hydrocracked distillate is much easier to desulfurize. Overall, this trend could increase projected desulfurization costs slightly. We plan to update these compositions to reflect trends in crude oil quality and refinery configuration in our analysis for the final rule to the extent that more recent data allow.

heating oil. Other refineries would shift the production of high sulfur diesel fuel and heating oil to the 500 ppm NRLM market. The second exception would be refiners granted special provisions due to the small size of their business (*i.e.*, SBREFA refiners) or economic hardship, as discussed in section IV above. The high sulfur distillate production levels of these refineries is small enough that they can sell into more local nonroad, locomotive and marine markets or the heating oil market without using pipelines and so they could continue to produce high sulfur distillate.

Based on refinery distillate production data from the Energy Information Administration (EIA), there are 122 refineries currently producing highway diesel fuel and 105 refineries producing high sulfur diesel fuel or heating oil. Using the methodology described above, absent this proposal, we project that roughly 114 refineries will invest in additional desulfurization equipment to produce 15 ppm highway diesel fuel; 74 refineries in 2006 and 40 in 2010.[273] These 114 refineries include 109 of the 122 refineries which currently produce highway diesel fuel, plus 5 refineries which currently only produce high sulfur distillate fuel today. Again absent the proposed NRLM diesel fuel program, we project that roughly 13 refineries currently producing highway diesel fuel will shift to producing high sulfur distillate fuel. This would leave a total of 113 refineries still producing high sulfur distillate after full implementation of the 2007 highway diesel fuel program.

The number of these 113 domestic refineries expected to produce either 500 ppm of 15 ppm NRLM diesel fuel in response to this proposal is summarized in Table V–A–2.

TABLE V–A–2 REFINERIES PROJECTED TO PRODUCE NRLM DIESEL FUEL UNDER THIS PROPOSAL

Year of Program	500 ppm diesel fuel		15 ppm diesel fuel	
	All refineries	Small refineries	All refineries	Small refineries
2007–2010	42	0	0	0
2010–2014	37	19	25	0
2014+	25	12	37	7

As shown in this table, we project that 42 of the 113 refineries currently producing some high sulfur distillate would desulfurize their high sulfur diesel fuel in response to the proposed 500 ppm standard in 2007. The remainder would continue producing either high sulfur NRLM diesel fuel under the proposed small refiner provisions, or high sulfur heating oil. As explained in section IV.F, we project that these refiners would use conventional hydrotreating technology to meet this standard. Of these 42 refineries, we project that 32 would build new hydrotreaters to meet the 500 ppm sulfur cap. We project that three of the remaining ten refineries would be able to meet the 500 ppm cap with their existing hydrotreater which is currently being used to produce highway diesel fuel. These three refineries are projected to build a new hydrotreater to produce 15 ppm highway diesel fuel in 2006, so their existing highway fuel hydrotreater could process their current high sulfur diesel fuel. The remaining seven refineries currently produce relatively small amounts of high sulfur diesel fuel compared to their highway diesel fuel production. We project that these refiners would be able to economically revamp their existing highway hydrotreater to process their non-highway diesel fuel.

We project that the capital cost involved to meet the 2007 500 ppm sulfur cap would be $600 million, or $9.7 million per refinery building a new hydrotreater. The bulk of this capital would be invested in 2007 ($500 million), with the remainder being invested in 2010.[274] Operating costs would be about $3 million per year for the average refinery. We request comment on the number of refiners who would need to build new equipment to meet the 500 ppm sulfur cap, the capital cost for this new equipment and the cost of operating this equipment.

Starting in mid-2010, we project that 25 refineries would add or revamp equipment to meet the 15 ppm cap on nonroad diesel fuel, while 20 refineries (nearly all of them small refiners) would add or revamp equipment to produce 500 ppm nonroad or locomotive and marine diesel fuel. Finally, an additional 12 refineries (again nearly all of them small refiners) would begin producing 15 ppm nonroad diesel fuel in 2014.

We project that 80 percent of the 15 ppm nonroad diesel fuel volume would be desulfurized by advanced technologies, while the remaining 20 percent would be desulfurized by conventional hydrotreaters. Since the bulk of the hydrotreating capacity being used to meet the 2007 500 ppm standard for NRLM diesel fuel would have just been built in 2007 or 2010, we expect that it would have been designed to facilitate further processing to 15 ppm sulfur and the added 15 ppm facilities would be revamps. However, those refiners who used their existing highway diesel fuel hydrotreaters to meet the proposed 500 ppm cap in 2007 would likely have to construct new equipment in 2010 or 2014 to meet the 15 ppm cap on nonroad diesel fuel, since these hydrotreaters could not be revamped in 2006 to produce 15 ppm highway diesel fuel. When the proposed NRLM diesel fuel program would be fully implemented in 2014, roughly 51 refineries are still projected to produce high sulfur heating oil and thus, would not face any refining costs related to this proposal.

Our projection that 80 percent of refineries would utilize some form of advanced technology to meet the proposed 15 ppm nonroad fuel sulfur cap is based on the fact that this 15 ppm cap would follow the production of 15 ppm highway diesel fuel by four years. Several firms are expending significant research and development resources to bring such advanced technologies to the market for the highway diesel fuel

[273] These (and the subsequent) estimates of the number of refineries investing in new equipment to produce diesel fuels of various sulfur levels should be understood as rough estimates which assist us in projecting costs and other impacts related to this proposal. They are most reasonable when evaluating the total number of refineries investing in a particular year or region. We are not indicating that we believe that we can predict which specific refineries would invest in desulfurization equipment in response to this proposal.

[274] Some refineries would be able to delay production of 500 ppm NRLM fuel until 2010 due to the proposed small refiner provisions. Likewise, some refineries would be able to delay production of 15 ppm nonroad diesel fuel until 2014.

program. We developed cost estimates for two such technologies: Linde Iso-Therming and Phillips S-Zorb. The development of cost estimates for these two advanced technologies, as well as conventional hydrotreating, is described in detail in Chapter 7 of the Draft RIA. We request comment on the potential viability and cost savings associated with advanced desulfurization technologies, particularly in the 2010 timeframe.

The total capital cost of new equipment and revamps related to the proposed 2010 sulfur standard would be $640 million, or $17 million per refinery adding or revamping equipment. Total operating costs would be about $5 million per year for the average refinery. The total refining cost, including the amortized cost of capital, would be 4.4 cents per gallon of new 15 ppm nonroad fuel. This cost is relative to the cost of producing high sulfur fuel today, and includes the cost of meeting the 500 ppm standard beginning in 2007. We request comment on the number of refiners who would need to build new equipment to meet the 15 ppm sulfur cap, the capital cost for this new equipment and the cost of operating this equipment. The average cost of continuing to meet the 500 ppm standard for locomotive and marine fuel would continue at 2.2 cents per gallon.

The above costs reflect national averages for the fully phased in program for each control step. Some refiners would face lower costs while others would face higher costs. Excluding small refiners because they are able to take advantage of the proposed small refiner provisions, the average refining costs by refining region are shown in the table below. Combined costs are shown for PADDs 1 and 3 because of the large volume of diesel fuel which is shipped from PADD 3 to PADD 1.

TABLE V–A–3.—AVERAGE REFINING COSTS BY REGION (CENTS PER GALLON)

	2007 500 ppm Cap	2010 15 ppm Cap
PADDs 1 and 3	1.4	2.6
PADD 2	2.9	5.7
PADD 4	4.0	8.5
PADD 5	2.6	5.4
Nationwide	2.2	4.4

We request comment on the range of estimated refining costs for the various regions for both the proposed 500 and 15 ppm sulfur caps.

2. Cost of Lubricity Additives

Hydrotreating diesel fuel tends to reduce the natural lubricating quality of diesel fuel, which is necessary for the proper functioning of certain fuel system components. There are a variety of fuel additives which can be used to restore diesel fuel's lubricating quality. These additives are currently used to some extent in highway diesel fuel. We expect that the need for lubricity additives that would result from the proposed 500 ppm sulfur standard for off-highway diesel engine fuel would be similar to that for highway diesel fuel meeting the current 500 ppm sulfur cap standard.[275] Industry experience indicates that the vast majority of highway diesel fuel meeting the current 500 ppm sulfur cap does not need lubricity additives. Therefore, we expect that the great majority of off-highway diesel engine fuel meeting the proposed 500 ppm sulfur standard would also not need lubricity additives. In estimating lubricity additive costs for 500 ppm diesel fuel, we assumed that fuel suppliers would use the same additives at the same concentration as we projected would be used in 15 ppm highway diesel fuel. Based on our analysis of this issue for the 2007 highway diesel fuel program, the cost per gallon of the lubricity additive is about 0.2 cent. This level of use is likely conservative, as the amount of lubricity additive needed increases substantially as diesel fuel is desulfurized to lower levels. We also project that only 5 percent of all 500 ppm NRLM diesel fuel would require the use of a lubricity additive. Thus, we project that the cost of additional lubricity additives for the affected 500 ppm NRLM diesel fuel would be 0.01 cent per gallon. See the Draft RIA for more details on the issue of lubricity additives.

We project that all nonroad diesel fuel meeting a 15 ppm cap would require treatment with lubricity additives. Thus, the projected cost would be 0.2 cent per affected gallon of 15 ppm nonroad diesel fuel.

3. Distribution Costs

The proposed fuel program is projected to impact distribution costs in three ways. One, we project that more diesel fuel would have to be distributed under the proposal than without it. This is due to the fact that some of the desulfurization processes reduce the fuel's volumetric energy density during processing. Total energy is not lost during processing, as the total volume of fuel is increased. However, a greater volume of fuel must be consumed in the engine to produce the same amount of power. We assumed that the current cost of distributing diesel fuel of 10 cents per gallon (*see* Draft RIA for further details) would stay constant (*i.e.*, a 1 percent increase in the amount of fuel distributed would increase total distribution costs by 1 percent).

We project that desulfurizing diesel fuel to 500 ppm would reduce volumetric energy content by 0.7 percent. This would increase the cost of distributing fuel by 0.07 cent per gallon. We project that desulfurizing diesel fuel to 15 ppm would reduce volumetric energy content by an additional 0.35 percent. This would increase the cost of distributing fuel by an additional 0.04 cent per gallon, or a total cost of 0.11 cent per gallon of affected 15 ppm nonroad diesel fuel.

Two, while this proposal minimizes the segregation of similar fuels, some additional segregation of products in the distribution system would still be required. The proposed allowance that highway and off-highway diesel engine fuel meeting the same sulfur specification can be shipped fungibly until it leaves the terminal obviates the need for additional storage tankage in this segment of the distribution system.[276] This proposal would also allow 500 ppm NRLM diesel fuel to be mixed with high-sulfur NRLM diesel fuel once the fuels are dyed to meet IRS requirements. This provision would ease the last part of the distribution of high-sulfur NRLM diesel fuel.

However, we expect that the implementation of the proposed 500 ppm standard for NRLM diesel fuel in 2007 would compel some bulk plants in those parts of the country still

[275] Please refer to section IV in today's preamble for additional discussion regarding our projections of the potential impact on fuel lubricity of this proposed rule.

[276] Including the refinery, pipeline, marine tanker, and barge segments of the distribution system.

distributing heating oil as a separate fuel grade to install a second diesel storage tank to handle this 500 ppm nonroad fuel. These bulk plants currently handle only high-sulfur fuel and hence would need a second tank to continue their current practice of selling fuel into the heating oil market in the winter and into the nonroad market in the summer.[277] We believe that some of these bulk plants would convert their existing diesel tank to 500 ppm fuel in order to avoid the expense of installing an additional tank. However, to provide a conservatively high estimate we assumed that 10 percent of the approximately 10,000 bulk plants in the U.S. (1,000) would install a second tank in order to handle both 500 ppm NRLM diesel fuel and heating oil. The cost of an additional storage tank at a bulk plant is estimated at $90,000 and the cost of de-manifolding their delivery truck at $10,000.[278] If all 1,000 bulk plants were to install a new tank, the total one-time capitol cost would be $100,000,000. Amortizing the capital costs over 20 years, results in a estimated cost for tankage at such bulk plants of 0.1 cent per gallon of affected NRLM diesel fuel supplied. Although the impact on the overall cost of the proposed program is small, the cost to those bulk plant operators who need to put in a separate storage tank may represent a substantial investment. Thus, as discussed in section IV.F., we believe many of these bulk plants could make other arrangements to continue servicing both heating oil and NRLM markets.

Due to the end of the highway program temporary compliance option (TCO) in 2010 and the disappearance of high-sulfur diesel fuel from much of the fuel distribution system due to the implementation of this proposed rule, we expect that storage tanks at many bulk plants which were previously devoted to 500 ppm TCO highway fuel and high-sulfur fuel would become available for dyed 15 ppm nonroad diesel service. Based on this assessment, we do not expect that a significant number of bulk plants would need to install an additional storage tank in order to provide dyed and undyed 15 ppm diesel fuel to their customers beginning in 2010 (the proposed implementation date for the 15 ppm nonroad standard).[279] There could potentially be some additional costs related to the need for new tankage in some areas not already carrying 500 ppm fuel under the temporary compliance option of the highway diesel program and which continue to carry high sulfur fuel. However, we expect them to minimal relative to the above 0.1 cent per gallon cost. Thus, we estimate that the total cost of additional storage tanks that would result from the adoption of this proposal would be 0.1 cent per gallon of affected off-highway diesel engine fuel supplied.

Three, the proposed requirement that high sulfur heating oil be marked between 2007 and 2010 and that locomotive and marine diesel fuel be marked from 2010 until 2014 would increase the cost of distributing these fuels slightly. Based on input from marker manufacturers, we estimate that marking these fuels would cost no more than 0.2 cent per gallon and could cost considerably less. There should be no capital cost associated with this requirement, as we are proposing to remove the current requirement that refiners dye all high sulfur distillate at the refinery. The current dyeing equipment should work equally well for the marker. Because heating oil is being marked to prevent its use in NRLM engines, we have spread the cost for this marker over NRLM diesel fuel. Thus, from a regulatory point of view, the heating oil marker would increase the cost of NRLM diesel fuel between 2007 and 2010 by 0.16 cent per gallon. We attribute the cost of marking 500 ppm locomotive and marine diesel fuel directly to this fuel, so the marker cost is simply 0.2 cent per gallon of locomotive and marine diesel fuel between 2010 and 2014.

We do not project any additional downgrade of 15 ppm diesel fuel would result from the proposed fuel program. In our analysis of the 15 ppm highway fuel program, we also projected additional distribution costs due to the need to downgrade more volume of highway diesel fuel to a lower value product. This is a consequence of the large difference between the sulfur content of 15 ppm fuel and other distillate products, like high sulfur diesel fuel, heating oil and jet fuel.[280] We do not project that these costs would increase with this proposed rule. Highway diesel fuel meeting a 15 ppm cap will already be being distributed in all major pipeline and terminal networks. Thus, we expect that 15 ppm nonroad fuel would be added to batches of 15 ppm already being distributed. In this situation, the total interface volume needing to be downgraded would not increase. At the same time, we are not projecting that interface volume would decrease, as high sulfur fuels, such as jet fuel, would still be in the system.

Thus, overall, we estimate that the total additional distribution would be 0.3 cent per gallon of nonroad, locomotive and marine fuel during the first step of the proposed program (from 2007 through 2010). We project that distribution costs would increase to 0.4 cent gallon for 500 ppm locomotive and marine diesel fuel from 2010 to 2014, but decrease to 0.2 cent per gallon thereafter. Finally, we project that distribution costs for 15 ppm nonroad diesel fuel would be 0.2 cent gallon.

4. How EPA's Projected Costs Compare to Other Available Estimates

We used two different methods for evaluating how well our cost estimates reflect the true costs for complying with the two step nonroad fuel program. The first method compared our costs with the incremental market price of diesel fuel meeting a 15 or 500 ppm standard. The second method compared our cost estimate to that from an engineering analysis analogous to the one we performed.

Beginning with market prices, highway diesel fuel meeting a 500 ppm sulfur cap has been marketed in the U.S. for almost ten years. Over the five year period from 1995–1999, its national average price has exceeded that of high sulfur diesel fuel by about 2.4 cent per gallon (*see* chapter 7 of the Draft RIA). While fuel prices are a often a function of market forces which might not reflect the cost of producing the fuel, the comparison of the price difference over a fairly long period such as 5 years would tend to reduce the effect of the market on the prices and more closely reflect the cost of complying with the 500 ppm cap standard. Thus, we feel that this is a sound basis for evaluating our cost estimate. This price difference is essentially the same as our estimated cost for refining and distributing 500 ppm non-highway diesel fuel, thus the price difference for producing and distributing 500 ppm highway fuel corroborates our cost analysis.

Some 15 ppm diesel fuel is marketed today. However, it is either being produced in very limited quantities using equipment designed to meet less

[277] *See* section IV.E.9. of this proposal and chapter 5 of the RIA for additional discussion of the potential impacts of the proposed sulfur standards on the distribution system.

[278] This estimated cost includes the addition of a separate delivery system on the tank truck.

[279] *See* section IV of today's preamble for additional discussion of our rational for this conclusion.

[280] Off-highway diesel fuel sulfur content is currently unregulated and is approximately 3,400 ppm on average. The maximum allowed sulfur content of heating oil is 5,000 ppm. The maximum allowed sulfur content of kerosene (and jet fuel) is 3,000 ppm.

stringent sulfur standards or with other properties which make it unrepresentative of typical U.S. NRLM diesel fuel. Thus, current market prices are not a good indication of the long term price impact of the proposed 15 ppm cap.

Regarding engineering studies, the Engine Manufactures Association (EMA) commissioned a study by Mathpro to estimate the cost of controlling the sulfur content of highway and nonroad diesel fuel to levels consistent with both 500 ppm and 15 ppm cap standards.[281] Mathpro used a higher rate of return on new capital so we adjusted their per-gallon costs to reflect our own amortization methodology. Also, the Mathpro study was completed in 1999 so we adjusted their costs for inflation to year 2002 dollars. After these two adjustments, Mathpro's cost to desulfurize the high sulfur non-highway pool to 500 ppm is 2.5 cents per gallon, while that for a 15 ppm cap is 5.8 cents per gallon.[282] The 500 ppm cost estimate compares quite favorably with our own estimate of 2.2 cents per gallon cost. One reason for our somewhat lower estimate for complying with the 500 ppm standard is that our refinery-specific analysis has only the lowest cost refineries complying as many more expensive refineries can continue to produce heating oil. It is likely that the refineries which our analysis show would comply are more optimized for desulfurizating diesel fuel than the average refinery used by Mathpro. This reason applies even more for 15 ppm cap standard as fewer, more optimized refineries need to comply to produce nonroad diesel fuel which complies with a 15 ppm sulfur cap standard. Furthermore, we considered the use of advanced desulfurization technologies for complying with the 15 ppm standard, while Mathpro did not. Since the Mathpro study was performed in 1999, cost estimates were not available for either of the two technologies which we included. The adjustment of the Mathpro costs and the comparison with our own cost estimates are discussed in detail in the Draft RIA. We request comment on the degree that the results of the Mathpro study for EMA and the comparison with real-world prices support our own cost estimates.

[281] Hirshfeld, David, MathPro, Inc., "Refining economics of diesel fuel sulfur standards," performed for the Engine Manufactuers Association, October 5, 1999.

[282] The Mathpro costs cited reflect their case where current diesel fuel hydrotreaters are revamped with a new reactor in series, which is the most consistent with our technology projection.

5. Supply of Nonroad, Locomotive and Marine Diesel Fuel

EPA has developed the proposed fuel program to minimize its impact on the supply of distillate fuel. For example: we have proposed to transition the fuel sulfur level down to 15 ppm in two steps, providing an estimated 6 years of leadtime for the final step; we are proposing to provide flexibility to refiners through the availability of banking and trading provisions; and we have provided relief for small refiners and hardship relief for any qualifying refiner. In order to evaluate the effect of this proposal on supply, EPA evaluated four possible cases: (1) whether the proposed standards could cause refiners to remove certain blendstocks from the fuel pool, (2) whether the proposed standards could require chemical processing which loses fuel in the process, (3) whether the cost of meeting the proposed standards could lead some refiners to leave that market, and (4) whether the cost of meeting the proposed standards could lead some refiners to stop operations altogether (*i.e.*, shut down). In all cases, as discussed below, we have concluded that the answer is no. Therefore, consistent with our findings made during the 2007 highway diesel rule, we do not expect this proposed rule to cause any supply shortages of nonroad, locomotive and marine diesel fuel. The reader is referred to the draft RIA for a more detailed discussion of the potential supply impact of this proposed rule.

Blendstock Shift: There should be no long term reduction in the amount of material derived from crude oil available for blending into diesel fuel or heating oil as a result of this proposal. Technology exists to desulfurize any commercial diesel fuel to less than 10 ppm sulfur. This technology is just now being proven on a commercial scale with a range of no. 2 diesel fuel blendstocks, as a number of refiners are producing 15 ppm fuel for diesel fleets which have been retro-fitted with PM traps or for pipeline testing. Therefore, there is no technical necessity to remove certain blendstocks from the diesel fuel pool. It costs more to process certain blendstocks, such as light cycle oil, than others. Therefore, there may be economic incentives to move certain blendstocks out of the diesel fuel market to reduce compliance costs. However, that is an economic issue, not a technical issue and will be addressed below when we consider whether refiners might choose to exit the NRLM diesel fuel market.

Processing Losses: The impact of the proposed rule on the total output of liquid fuel from refineries would be negligible. Conventional desulfurization processes do not reduce the energy content of the input material. However, the form of the material is affected slightly. With conventional hydrotreating, about 98 percent of the diesel fuel fed to a hydrotreater producing 15 ppm sulfur product leaves as diesel fuel. Of the 2 percent loss, three-fourths, or about 1.5 percent leaves the unit as naphtha (*i.e.*, gasoline feedstock). The remainder is split evenly between liquified petroleum gas (LPG) and refinery fuel gas. Both naphtha and LPG have higher valuable uses as liquid fuels. Naphtha can be used to produce gasoline. Refiners can adjust the relative amounts of gasoline and diesel fuel which they produce, especially to this small degree. This additional naphtha can displace other gasoline blendstocks, which can then be shifted to the diesel fuel pool. LPG, on the other hand, is primarily used in heating, where it competes with heating oil. Thus, additional LPG can be used to displace gasoline and heating oil, which in turn can be shifted to the diesel fuel pool. Thus, there should be little or no direct impact of desulfurization on refinery fuel production. The shift from diesel fuel to fuel gas is very small (0.25 percent) and this fuel gas can be used to reduce consumption of natural gas within the refinery. These figures apply to the full effect of the proposed standards (*i.e.*, the reduction in sulfur content from 3400 ppm to 15 ppm). For the first step of the proposed fuel program and that portion of the diesel fuel pool which would remain at the 500 ppm level indefinitely, the impacts would only be about 40 percent of those described above.

The use of advanced desulfurization technologies would further reduce these impacts. These technologies are projected to be used in the second step of reducing 500 ppm diesel fuel to 15 ppm sulfur. We project that the Linde process would reduce the above losses for the second step by 55 percent, while the Phillips SZorb process would have no loss in diesel fuel production.

Exit the NRLM Diesel Fuel Market: While the cost of meeting the proposed standards might cause some individual refiners to consider reducing their production of NRLM fuel or leave the market entirely, we do not believe that across the entire industry such a shift is possible or likely. As mentioned above, all diesel fuels and heating oil are essentially identical both chemically and physically, except for sulfur level. Thus, if a refiner could shift his high sulfur distillate material from the nonroad, locomotive and marine diesel fuel markets to the heating oil market starting in mid-2007, it would avoid the need to invest in new desulfurization equipment. Likewise, starting in mid-2010, a refiner could focus his 500 ppm diesel fuel in the locomotive and marine diesel fuel markets or shift this material to the heating oil market. The problem would be a potential oversupply of heating oil starting in 2007 and locomotive and marine diesel fuel and heating oil starting in 2010. An oversupply could lead to a substantial drop in market price, significantly increasing the cost of leaving the nonroad, locomotive and marine diesel fuel markets. Or, it may be necessary to export the higher sulfur fuel in order to sell it. This could entail transportation costs and overseas prices no higher than existed in the U.S. before the oversupply (and possibly lower due to these imports now entering these overseas markets).

We addressed this same issue during the development of 2007 highway diesel fuel program. There, the issue was whether refiners would shift some or all of their current highway diesel fuel production to either domestic or overseas markets for high sulfur diesel fuel or heating oil in order to avoid investing to meet the 15 ppm cap for highway diesel fuel. A study by Charles River Associates, *et al.,* sponsored by API projected that there could be a near-term shortfall in highway diesel fuel supply of as much as 12 percent.[283] However, supported by a study by Muse, Stancil, we concluded that refiners would incur greater economic loss in trying to avoid meeting the 15 ppm highway diesel fuel cap than they would by complying at current production levels even if the market did not allow them to recover their capital investment. A study by Mathpro, Inc. for AAM and EMA also criticized the conclusions of the Charles River study, particularly their assumption that compliance costs alone would drive investment decisions and that there was essentially a single highway diesel fuel market nationwide.[284] Mathpro demonstrated that smaller refineries located, for example, in the Rocky Mountain region, likely faced higher per gallon compliance costs, but also had been more profitable over the past 15 years than larger refiners in other areas with lower overall costs. This was due to their market niches and the inability for lower cost refiners to ship large volumes of fuel economically to their market.

We believe that the same conclusions apply to the proposed fuel program for six reasons. One, the alternative markets for high sulfur diesel fuel and heating oil would be even more limited after the proposed sulfur caps on nonroad, locomotive and marine diesel fuel than they will be in 2006, as half of the current U.S. market for high sulfur, no. 2 distillate would disappear. We expect that high sulfur heating oil would not even by carried be common carrier pipelines except those serving the Northeast. Therefore, refiners' sale of high sulfur distillate may be limited to markets serviceable by truck. Two, the desulfurization technology to meet a 500 ppm cap has been commercially demonstrated for over a decade. The desulfurization technology to meet a 15 ppm cap will have been commercially demonstrated in mid-2006, a full four years prior to the implementation of the 15 ppm cap on nonroad diesel fuel. Three, the volume of fuel affected by the 15 ppm nonroad diesel fuel standard would be only one-seventh of that affected by the highway diesel fuel program. This dramatically reduces the required capital investment. Four, both Europe and Japan are implementing sulfur caps for highway and nonroad diesel fuel in the range of 10–15 ppm, eliminating these markets as a sink for high sulfur diesel fuel. Five, refineries outside of the U.S. and Europe are operating at a lower percentage of their capacity than U.S. refineries. Thus, U.S. refineries would not be able to obtain attractive prices for high sulfur diesel fuel overseas. Finally, refinery profit margins were much higher during the last part of 2000 and most of 2001 than over the past ten years, indicating a potential long-term improvement in profitability. Margins decreased again during most in 2002, but recovered during the last few months of that year and in early 2003.

Once refiners have made their investments to meet the proposed NRLM diesel fuel standards, or have decided to produce high sulfur heating oil, we expect that the various distillate markets would operate very similar to today's markets. When fully implemented in 2014, there will be three distillate fuels in the market, 15 ppm highway and nonroad diesel fuel, 500 ppm locomotive and marine diesel fuel and high sulfur heating oil. The market for 500 ppm locomotive and marine diesel fuel is much smaller than the other two, particularly considering that it is nationwide and the heating oil market is geographically concentrated. Therefore, the vast majority of refiners are expected to focus on producing either 15 ppm or high sulfur distillate, which is similar to today, where there are two fuels, 500 ppm and high sulfur distillate. In this case, refiners with the capability of producing 15 ppm diesel fuel have the most flexibility, since they can sell their fuel to any of the three markets. Refiners with only 500 ppm desulfurization capability can supply two markets. Those refiners only capable of producing high sulfur distillate would not be able to participate in either the 15 or 500 ppm markets. However, this is not different from today. Generally, we do not expect one market to provide vastly different profit margins than the others, as high profit margins in one market will attract refiners from another via investment in desulfurization equipment.

Refinery Closure: There are a number of reasons why we do not believe that refineries would completely close down under this proposed rule. One reason is that we have included provisions to provide relief for small refiners, as well as any refiner facing unusual financial hardship. Another reason is that nonroad, locomotive and marine diesel fuel is usually the third or fourth most important product produced by the refinery from a financial perspective. A total shutdown would mean losing all the revenue and profit from these other products. Gasoline is usually the most important product, followed by highway diesel fuel and jet fuel. A few refineries do not produce either gasoline or highway diesel fuel, so jet fuel and high sulfur diesel fuel and heating oil are their most important products. The few refiners in this category likely face the biggest financial challenge in meeting the proposed requirements. However, those refiners would also presumably be in the best position to apply for special hardship provisions, presuming that they do not have readily available source of investment capital. The additional time afforded by these provisions should allow the refiner to generate sufficient cash flow to invest in the required desulfurization equipment. Investment here could also provide them the opportunity to expand into more profitable (*e.g.*, highway diesel) markets.

A quantitative evaluation of whether the cost of the proposed fuel program could cause some refineries to cease operations completely would be very difficult, if not impossible to perform. A

[283] ''An Assessment of the Potential Impacts of Proposed Environmental Regulations on U.S. Refinery Supply of Diesel Fuel,'' Charles River Associates and Baker and O'Brien, for API, August 2000.

[284] ''Prospects for Adequate Supply of Ultra Low Sulfur Diesel Fuel in the Transition Period (2006–2007), An Analysis of Technical and Economic Driving Forces for Investment in ULSD Capacity in the U.S. Refining Sector,'' MathPro, Inc., for AAM and EMA, December 7, 2001.

major factor in any decision to shut down is the refiner's current financial situation. It is very difficult to assess an individual refinery's current financial situation. This includes a refiner's debt, as well as its profitability in producing fuels other than those affected by a particular regulation. It can also include the profitability of other operations and businesses owned by the refiner.

Such an intensive analysis can be done to some degree in the context of an application for special hardship provisions, as discussed above. However, in this case, EPA can request detailed financial documents not normally available. Prior to such application, as is the case now, this financial information is usually confidential. Even when it is published, the data usually apply to more than just the operation of a single refinery.

Another factor is the need for capital investments other than for this proposed rule. EPA can roughly project the capital needed to meet other new fuel quality specifications, such as the Tier 2 or highway diesel sulfur standards. However, we cannot predict investments to meet local environmental and safety regulations, nor other investments needed to compete economically with other refiners.

Finally, any decision to close in the future must be based on some assumption of future fuel prices. Fuel prices are very difficult to project in absolute terms. The response of prices to changes in fuel quality specifications, such as sulfur content, as is discussed in the next section, are also very difficult to predict. Thus, even if we had complete knowledge of a refiner's financial status and its need for future investments, the decision to stay in business or close would still depend on future earnings, which are highly dependent on the prices of all products produced by that refinery.

Some studies in this area point to fuel pricing over the past 15 years or so and conclude that prices will only increase to reflect increased operating costs and will not reflect the cost of capital. In fact, the rate of return on refining assets has been poor over the past 15 years and until recently, there has been a steady decline in the number of refineries operating in the U.S. However, this may have been due to a couple of circumstances specific to that time period. One, refinery capacity utilization was less than 80 percent in 1985. Two, at least regarding gasoline, the oxygen mandate for reformulated gasoline caused an increase in gasoline supply despite low refinery utilization rates. While this led to healthy financial returns for oxygenate production, it did not help refining profit margins.

Today, refinery capacity utilization in the U.S. is generally considered to be at its maximum sustainable rate. There are no regulatory mandates on the horizon which will increase production capacity significantly, even if ethanol use in gasoline increases substantially.[285] Consistent with this, refining margins have been much better over the past two and a half years than during the previous 15 years and the refining industry itself is projecting good returns for the foreseeable future.

6. Fuel Prices

It is well known that it is difficult to predict fuel prices in absolute terms with any accuracy. The price of crude oil dominates the cost of producing gasoline and diesel fuel. Crude oil prices have varied by more than a factor of two in the past year. In addition, unexpectedly warm or cold winters can significantly affect heating oil consumption, which affects the amount of gasoline produced and the amount of distillate material available for diesel fuel production. Economic growth, or its lack, affects fuel demand, particularly for diesel fuel. Finally, both planned and unplanned shutdowns of refineries for maintenance and repairs can significantly affect total fuel production, inventory levels and resulting fuel prices.

Predicting the impact of any individual factor on fuel price is also difficult. The overall volatility in fuel prices limits the ability to determine the effect of a factor which changed at a specific point in time which might have led to the price change, as other factors continue to change over time. Occasionally, a fuel quality change, such as reformulated gasoline or a 500 ppm cap on diesel fuel sulfur content, only affects a portion of the fuel pool. In this case, an indication of the impact on price can be inferred by comparing the prices of the two fuels at the same general location over time. However, this is still only possible after the fact, and cannot be done before the fuel quality change takes place.

Because of these difficulties, EPA has generally not attempted to project the impact of its rules on fuel prices. However, in response to Executive Order 13211, we are doing so for this proposed rule. To reflect the inherent uncertainty in making such projections, we developed three projections for the potential impact of the proposed fuel program on fuel prices. The range of potential long-term price increases are shown in Table V-A–4. Short-term price impacts are highly volatile, as are short-term swings in absolute fuel prices, and much too dependent on individual refiners' decisions, unexpected shutdowns, etc. to be predicted even with broad ranges.

TABLE V–A–4.—RANGE OF POSSIBLE TOTAL DIESEL FUEL PRICE INCREASES (CENTS PER GALLON) [a]

	Lower Limit	Mid-Point	Maximum
2007 500 ppm Sulfur Cap: Nonroad, Locomotive and Marine Diesel Fuel			
PADDs 1 and 3	0.9	1.5	3.4
PADD 2	2.3	3.0	4.8
PADD 4	1.7	4.1	5.8
PADD 5	1.0	2.8	4.3
2010 15 ppm Sulfur Cap: Nonroad Diesel Fuel			
PADDs 1 and 3	1.8	3.0	5.4
PADD 2	2.9	6.1	7.4
PADD 4	3.0	8.9	9.3
PADD 5	1.7	5.9	8.4

Notes:
[a] At the current wholesale price of approximately $1.00 per gallon, these values also represent the percentage increase in diesel fuel price.

[285] Both houses of the U.S. Congress are considering bills which would require the increased use of renewables, like ethanol, in gasoline and diesel fuel. While the amount of renewables could be considerable, it is well below the annual growth in transportation fuel use.

The lower end of the range assumes that prices within a PADD increased to reflect the highest operating cost increase faced by any refiner in that PADD. In this case, this refiner with the highest operating cost would not recover any of his invested capital, but all other refiners would recover some or all of their investment. In this case, the price of nonroad, locomotive and marine diesel fuel would increase in 2007 by 1–2 cents per gallon, depending on the area of the country. In 2010, the price of nonroad diesel fuel would increase a total of 2–3 cents per gallon. Locomotive and marine diesel fuel prices would continue to increase by 1–2 cents per gallon.

The mid-range estimate of price impacts assumes that prices within a PADD increase by the average refining and distribution cost within that PADD, including full recovery of capital (at 7 percent per annum before taxes). Lower cost refiners would recover more than their capital investment, while those with higher than average costs recover less. Under this assumption, the price of nonroad, locomotive and marine diesel fuel would increase in 2007 by 2–4 cents per gallon, depending on the area of the country. In 2010, the price of nonroad diesel fuel would increase a total of 3–9 cents per gallon. Locomotive and marine diesel fuel prices would continue to increase by 2–4 cents per gallon.

The upper end estimate of price impacts assumes that prices within a PADD increase by the maximum total refining and distribution cost of any refinery within that PADD, including full recovery of capital (at 7 percent per annum before taxes). All other refiners would recover more than their capital investment. Under this assumption, the price of nonroad, locomotive and marine diesel fuel would increase in 2007 by 3–6 cents per gallon, depending on the area of the country. In 2010, the price of nonroad diesel fuel would increase a total of 5–9 cents per gallon. Locomotive and marine diesel fuel prices would continue to increase by 3–6 cents per gallon.

In addition to the differences noted above, there are a number of assumptions inherent in all three of the above price projections. First, both the lower and upper limits of the projected price impacts described above assume that the refinery facing the highest compliance costs is currently the price setter in their market. This is a worse case assumption which is impossible to validate. Many factors affect a refinery's total costs of fuel production. Most of these factors, such as crude oil cost, labor costs, age of equipment, etc., are not considered in projecting the incremental costs associated with lower NRLM diesel fuel sulfur levels. Thus, current prices may very well be set in any specific market by a refinery facing lower incremental compliance costs than other refineries. This point was highlighted in a study by the National Economic Research Associates (NERA) for AAM of the potential price impacts of EPA's 2007 highway diesel fuel program.[286] In that study, NERA criticized the above referenced study performed by Charles River Associates, *et al.* for API, which projected that prices would increase nationwide to reflect the total cost faced by the U.S. refinery with the maximum total compliance cost of all the refineries in the U.S. producing highway diesel fuel. To reflect the potential that the refinery with the highest projected compliance costs under the maximum price scenario is not the current price setter, we included the mid-point price impacts above. It is possible that even the lower limit price impacts are too high, if the conditions exist where prices are set based on operating costs alone. However, these price impacts are sufficiently low that considering even lower price impacts was not considered critical to estimating the potential economic impact of this rule.

Second, we assumed that a single refinery's costs could affect fuel prices throughout an entire PADD. While this is a definite improvement over analyses which assume that a single refinery's costs could affect fuel prices throughout the entire nation, it is still conservative. High cost refineries are more likely to have a more limited geographical impact on market pricing than an entire PADD.

Third, by focusing solely on the cost of desulfurizing NRLM diesel fuel, we assume that the production of NRLM diesel fuel is independent of the production of other refining products, such as gasoline, jet fuel and highway diesel fuel. However, this is clearly not the case. Refiners have some flexibility to increase the production of one product without significantly affecting the others, but this flexibility is quite limited. It is possible that the relative economics of producing other products could influence a refiner's decision to increase or decrease the production of NRLM diesel fuel under the proposed standards. This in turn could increase or decrease the price impact relative to those projected above.

Fourth, all three of the above price projections are based on the projected cost for U.S. refineries of meeting the proposed NRLM diesel fuel sulfur caps. Thus, these price projections assume that imports of NRLM fuel, which are currently significant in the Northeast, are available at roughly the same cost as those for U.S. refineries in PADDs 1 and 3. We have not performed any analysis of the cost of lower sulfur caps on diesel fuel produced by foreign refiners. However, there are reasons to believe that imports of 500 and 15 ppm NRLM diesel fuel would be available at prices in the ranges of those projected for U.S. refiners.

One recent study analyzed the relative cost of lower sulfur caps for Asian refiners relative to those in the U.S., Europe and Japan.[287] It concluded that costs for Asian refiners would be comparatively higher, due to the lack of current hydrotreating capacity at Asian refineries. This conclusion is certainly valid when evaluating lower sulfur levels for highway diesel fuels which are already at low levels in the U.S., Europe and Japan and for which refineries in these areas have already invested in hydrotreating capacity. It would appear to be less valid when assessing the relative cost of meeting lower sulfur standards for nonroad diesel fuels and heating oils which are currently at much higher sulfur levels in the U.S., Europe and Japan. All refineries face additional investments to remove sulfur from these fuels and so face roughly comparable control costs on a per gallon basis.

One factor arguing for competitively priced imports is the fact that refinery utilization rates are currently higher in the U.S. and Europe than in the rest of the world. The primary issue is whether overseas refiners will invest to meet tight sulfur standards for U.S., European and Japanese markets. Many overseas refiners will not invest, instead focusing on local, higher sulfur markets. However, many overseas refiners focus on exports. Both Europe and the U.S. are moving towards highway and nonroad diesel fuel sulfur caps in the 10–15 ppm range. Europe is currently and projected to continue to need to import large volumes of highway diesel fuel. Thus, it seems reasonable to expect that a number of overseas refiners would invest in the capacity to produce some or all of their diesel fuel at these levels. Overseas refiners also have the flexibility to produce 10–15 ppm diesel fuel from their cleanest blendstocks, as

[286] "Potential Impacts of Environmental Regulations on Diesel Fuel Prices," NERA, for AAM, December 2000.

[287] "Cost of Diesel Fuel Desulfurization In Asian Refineries," Estrada International Ltd., for the Asian Development Bank, December 17, 2002.

most of their available markets have less stringent sulfur standards. Thus, there are reasons to believe that some capacity to produce 10–15 ppm diesel fuel would be available overseas at competitive prices. If these refineries were operating well below capacity, they might be willing to supply complying product at prices which only reflect incremental operating costs. This could hold prices down in areas where importing fuel is economical. However, it is unlikely that these refiners could supply sufficient volumes to hold prices down nationwide. Despite this expectation, to be conservative, in the refining cost analysis conducted earlier in this chapter, we assumed no imports of 500 ppm or 15 ppm NRLM diesel fuel. All 500 ppm and 15 ppm nonroad diesel fuel was produced by domestic refineries. This raised the average and maximum costs of 500 ppm and 15 ppm NRLM diesel fuel and increased the potential price impacts projected above beyond what would have been projected had we projected that 5–10 percent of NRLM diesel fuel would be imported at competitive prices.

B. Cost Savings to the Existing Fleet from the Use of Low Sulfur Fuel

We estimate that reducing fuel sulfur to 500 ppm would reduce engine wear and oil degradation to the existing nonroad diesel equipment fleet and that a further reduction to 15 ppm sulfur would result in even greater reductions. This reduction in wear and oil degradation would provide a dollar savings to users of nonroad equipment. The cost savings would also be realized by the owners of future nonroad engines that are subject to the standards in this proposal. As discussed below, these maintenance savings have been conservatively estimated to be greater than 3 cents per gallon for the use of 15 ppm sulfur fuel when compared to the use of today's unregulated nonroad diesel fuel. A summary of the benefits of low-sulfur fuel is presented in Table V.B–1.[288]

TABLE V.B–1—ENGINE COMPONENTS POTENTIALLY AFFECTED BY LOWER SULFUR LEVELS IN DIESEL FUEL

1Affected Components	Effect of Lower Sulfur	Potential Impact on Engine System
Piston Rings	Reduced corrosion wear	Extended engine life and less frequent rebuilds.
Cylinder Liners	Reduced corrosion wear	Extended engine life and less frequent rebuilds.
Oil Quality	Reduced deposits, reduced acid build-up, and less need for alkaline additives.	Reduce wear on piston ring and cylinder liner and less frequent oil changes.
Exhaust System (tailpipe)	Reduced corrosion wear	Less frequent part replacement.
Exhaust Gas Recirculation System.	Reduced corrosion wear	Less frequent part replacement.

The monetary value of these benefits over the life of the equipment will depend upon the length of time that the equipment operates on low-sulfur diesel fuel and the degree to which engine and equipment manufacturers specify new maintenance practices and the degree to which equipment operators change engine maintenance patterns to take advantage of these benefits. For equipment near the end of its life in the 2008 time frame, the benefits will be quite small. However, for equipment produced in the years immediately preceding the introduction of 500 ppm sulfur fuel, the savings would be substantial. Additional savings would be realized in 2010 when the 15 ppm sulfur fuel would be introduced.

We estimate the single largest savings would be the impact of lower sulfur fuel on oil change intervals. The draft RIA presents our analysis for the oil change interval extension which would be realized by the introduction of 500 ppm sulfur fuel in 2007, as well as the additional oil extension which would be realized with the introduction of 15 ppm sulfur nonroad diesel fuel in 2010. As explained in the draft RIA, these estimates are based on our analysis of publically available information from nonroad engine manufacturers. Due to the wide range of diesel fuel sulfur which today's nonroad engines may see around the world, engine manufacturers specify different oil change intervals as a function of diesel sulfur levels. We have used this data as the basis for our analysis. Taken together, when compared to today's relatively high nonroad diesel fuel sulfur levels, we estimate the use of 15 ppm sulfur fuel will enable an oil change interval extension of 35 percent from today's products.

We present here a fuel cost savings attributed to the oil change interval extension in terms of a cents per gallon operating cost. We estimate that an oil change interval extension of 31 percent, as would be enabled by the use of 500 ppm sulfur fuel in 2007, results in a fuel operating costs savings of 3.0 cents per gallon for the nonroad fleet. We project an additional cost savings of 0.3 cents per gallon for the oil change interval extension which would be enabled by the use of 15 ppm sulfur beginning in 2010. Thus, for the nonroad fleet as a whole, beginning in 2010 nonroad equipment users can realize an operating cost savings of 3.3 cents per gallon compared to today's engine. This means that the end cost to the typical user for 15ppm sulfur fuel is approximately 1.5 cents per gallon (4.8 cent per gallon cost for fuel minus 3.3 cent per gallon maintenance savings). For a typical 100 horsepower nonroad engine this represents a net present value lifetime savings of more than $500.

These savings will occur without additional new cost to the equipment owner beyond the incremental cost of the low-sulfur diesel fuel, although these savings are dependent on changes to existing maintenance schedules. Such changes seem likely given the magnitude of the savings. We have not estimated the value of the savings from the other benefits listed in Table V.B–1, and therefore we believe the 3.3 cents per gallon savings is conservative as it only accounts for the impact of low sulfur fuel on oil change intervals.

C. Engine and Equipment Cost Impacts

The following sections briefly discuss the various engine and equipment cost elements considered for this proposal and present the total costs we have estimated; the reader is referred to the draft RIA for a complete discussion. Estimated engine and equipment costs depend largely on both the size of the piece of equipment and its engine, and on the technology package being added to the engine to ensure compliance with the proposed standards. The wide size variation (*e.g.*, <4 horsepower engines through >2500 horsepower engines) and

[288] *See* Heavy-duty 2007 Highway Final RIA, Chapter V.C.5, and "Study of the Effects of Reduced Diesel Fuel Sulfur Content on Engine Wear", EPA report # 460/3–87–002, June 1987.

the broad application variation (*e.g.*, lawn equipment through large mining trucks) that exists in the nonroad industry makes it difficult to present here an estimated cost for every possible engine and/or piece of equipment. Nonetheless, for illustrative purposes, we present some example per engine/equipment cost impacts throughout this discussion. This analysis is presented in detail in Chapter 6 of the draft RIA. We are also considering doing a sensitivity analysis on cost/engine data, which would be put into the docket for comment.

It is important to note that the costs presented here do not reflect any savings that are expected to occur because of the engine ABT program and the equipment manufacturer transition program, both of which are discussed in Section VII. As discussed in the draft RIA, these optional programs have the potential to provide significant savings for both engine and equipment manufacturers. We request comment with supporting data and/or analysis on the cost estimates presented here and the underlying analysis presented in chapter 6 of the draft RIA.

1. Engine Cost Impacts

Estimated engine costs are broken into fixed costs (for research and development, retooling, and certification), variable costs (for new hardware and assembly time), and life-cycle operating costs. Total operating costs include the estimated incremental cost for low-sulfur diesel fuel, any expected increases in maintenance costs associated with new emission control devices, any costs associated with increased fuel consumption, and any decreases in operating cost (*i.e.*, maintenance savings) expected due to low-sulfur fuel. Cost estimates presented here represent an expected incremental cost of engines in the model year of their introduction. Costs in subsequent years would be reduced by several factors, as described below. All engine and equipment costs are presented in 2001 dollars.

a. Engine Fixed Costs

i. Engine and Emission Control Device R&D

The technologies described in section III represent those technologies we believe will be used to comply with the proposed Tier 4 emission standards. These technologies are part of an ongoing research and development effort geared toward compliance with the 2007 heavy-duty diesel highway emission standards. The engine manufacturers making R&D expenditures toward compliance with highway emission standards will have to undergo some additional R&D effort to transfer emission control technologies to engines they wish to sell into the nonroad market. These R&D efforts will allow engine manufacturers to develop and optimize these new technologies for maximum emission-control effectiveness with minimum negative impacts on engine performance, durability, and fuel consumption. Many nonroad engine manufacturers are not part of the ongoing R&D effort toward compliance with highway emissions standards because they do not sell engines into the highway market. These manufacturers are expected to benefit from the R&D work that has already occurred and will continue through the coming years through their contact with highway manufacturers, emission control device manufacturers, and the independent engine research laboratories conducting relevant R&D.

Several technologies are projected for complying with the proposed Tier 4 emission standards. We are projecting that NO_X adsorbers and catalyzed diesel particulate filters (CDPFs) would be the most likely technologies applied by industry to meet our proposed emissions standards for >75 horsepower engines. The fact that these technologies are being developed for implementation in the highway market prior to the implementation dates in this proposal, and the fact that engine manufacturers would have several years before implementation of the proposed Tier 4 standards, ensures that the technologies used to comply with the nonroad standards would undergo significant development before reaching production. This ongoing development could lead to reduced costs in three ways. First, we expect research will lead to enhanced effectiveness for individual technologies, allowing manufacturers to use simpler packages of emission control technologies than we would predict given the current state of development. Similarly, we anticipate that the continuing effort to improve the emission control technologies will include innovations that allow lower-cost production. Finally, we believe that manufacturers would focus research efforts on any drawbacks, such as fuel economy impacts or maintenance costs, in an effort to minimize or overcome any potential negative effects.

We anticipate that, in order to meet the proposed standards, industry would introduce a combination of primary technology upgrades. Achieving very low NO_X emissions would require basic research on NO_X emission control technologies and improvements in engine management to take advantage of the exhaust emission control system capabilities. The manufacturers are expected to take a systems approach to the problem of optimizing the engine and exhaust emission control system to realize the best overall performance. Since most research to date with exhaust emission control technologies for nonroad applications has focused on retrofit programs, there remains room for significant improvements by taking such a systems approach. The NO_X adsorber technology in particular is expected to benefit from re-optimization of the engine management system to better match the NO_X adsorber's performance characteristics. The majority of the dollars we have estimated for research is expected to be spent on developing this synergy between the engine and NO_X exhaust emission control systems. Therefore, for engines requiring both a CDPF and a NO_X adsorber (*i.e.*, >75 horsepower), we have attributed two-thirds of the R&D expenditures to NO_X control, and one-third to PM control.

In the 2007 HD highway rule, we estimated that each engine manufacturer would expend $35 million for R&D to redesign their engines and apply catalyzed diesel particulate filters (CDPF) and NO_X adsorbers. For their nonroad R&D efforts on engines requiring CDPFs and NO_X adsorbers (*i.e.*, >75 horsepower), engine manufacturers selling into the highway market would incur some level of R&D effort but not at the level incurred for the highway rule. In many cases, the engines used by highway manufacturers in nonroad products are based on the same engine platform as those used in highway products. However, horsepower and torque characteristics are often different so some effort will have to be expended to accommodate those differences. For these manufacturers, we have estimated that they would incur an R&D expense of $3.5 million. This $3.5 million R&D expense would allow for the transfer of R&D knowledge from their highway experience to their nonroad engine product line. Two-thirds of this R&D is attributed to NO_X control and one-third to PM control.

For those manufacturers that sell engines only into the nonroad market, and where those engines require a CDPF and a NO_X adsorber, we believe that they will incur an R&D expense nearing that incurred by highway manufacturers for the highway rule, although not at the level incurred by highway manufacturers for the highway rule. Nonroad manufacturers would be able to learn from the R&D efforts already under way for both the highway rule and for the Tier 2 light-duty highway rule (65 FR 6698). This learning could be done via seminars, conferences, and contact with highway manufacturers, emission control device manufacturers, and the independent engine research laboratories conducting relevant R&D. Therefore, for these manufacturers, we have estimated an expenditure of $24.5 million. This lower number—$24.5 million versus $35 million in the highway rule—reflects the transfer of knowledge to nonroad manufacturers that would occur from the many stakeholders in the diesel industry. Two-thirds of this R&D is attributed to NO_X control and one-third to PM control.

Note that the $3.5 million and $24.5 million estimates represent our estimate of the average R&D expected by manufacturers. These estimates would be different for each manufacturer—some higher, some lower—depending on product mix and the ability to transfer knowledge from one product to another.

For those engine manufacturers selling engines that would require CDPF-only R&D (*i.e.*, 25 to 75 horsepower engines in 2013), we have estimated that the R&D they would incur would be roughly one-third that incurred by manufacturers conducting CDPF/NO_X adsorber R&D. We believe this is a good estimate because CDPF technology is further along in its development than is NO_X adsorber technology and, therefore, a 50/50 split would not be appropriate. Using this estimate, the R&D incurred by manufacturers that have already done selling any engines into both the highway and the nonroad markets would be $1.2 million, and the R&D for manufacturers selling engines into only the nonroad market would be roughly $8 million. All of this R&D is attributed to PM control.

For those engine manufacturers selling engines that would require DOC-only or some engine-out modification R&D (*i.e.*, <75 horsepower engines in 2008), we have estimated that the R&D they would incur would be roughly one-half the amount estimated for their CDPF-only R&D. Using this estimate, the R&D incurred by manufacturers selling any engines into both the highway and nonroad markets would be roughly $600,000, and the R&D for manufacturers selling engines into only the nonroad market would be roughly $4 million. All of this R&D is attributed to PM control.

Some manufacturers of engines produce engines to specifications developed by other manufacturers. Such joint venture manufacturers do not conduct engine-related R&D but simply manufacture an engine designed and developed by another manufacturer. For such manufacturers, we have assumed no R&D expenditures given that we believe they will conduct no R&D themselves and will rely on their joint venture partner. This is true unless the parent company has no engine sales in the horsepower categories covered by the partner company. Under such a situation, we have accounted for the necessary R&D by attributing it to the parent company. We have also estimated that some manufacturers will choose not to invest in R&D for the U.S. nonroad market due to low volume sales that probably cannot justify the expense. More detail on these assumptions and the number of manufacturers assumed not to expend R&D is presented in Chapter 6 of the draft RIA. We welcome comments and supporting documentation.

We have assumed that all R&D expenditures occur over a five year span preceding the first year any emission control device is introduced into the market. Where a phase-in exists (*e.g.*, for NO_X standards on >75 horsepower engines), expenditures are assumed to occur over the five year span preceding the first year NO_X adsorbers would be introduced, and then to continue during the phase-in years; the expenditures would be incurred in a manner consistent with the phase-in of the standard. All R&D expenditures are then recovered by the engine manufacturer over an identical time span following the introduction of the technology. We assume a seven percent rate of return for all R&D. We have apportioned these R&D costs across all engines that are expected to use these technologies, including those sold in other countries or regions that are expected to have similar standards. We have estimated the fraction of the U.S. sales to this total sales at 42 percent. Therefore, we have attributed this amount to U.S. sales.

Using this methodology, we have estimated the total R&D expenditures attributable to the proposed standards at $199 million.

ii. Engine-Related Tooling Costs

Once engines are ready for production, new tooling will be required to accommodate the assembly of the new engines. In the 2007 highway rule, we estimated approximately $1.6 million per engine line for tooling costs associated with CDPF/NO_X adsorber systems. For the proposed nonroad Tier 4 standards, we have estimated that nonroad-only manufacturers would incur the same $1.6 million per engine line requiring a CDPF/NO_X adsorber system and that these costs would be split evenly between NO_X control and PM control. For those systems requiring only a CDPF, we have estimated one-half that amount, or $800,000 per engine line. For those systems requiring only a DOC or some engine-out modifications, we have applied a one-half factor again, or $400,000 per engine line. Tooling costs for CDPF-only and for DOC engines are attributed solely to PM control.

For those manufacturers selling into both the highway and nonroad markets, we have estimated one-half the baseline tooling cost, or $800,000, for those engine lines requiring a CDPF/NO_X adsorber system. We believe this is reasonable since many nonroad engines are produced on the same engine line with their highway counterparts. For such lines, we believe very little to no tooling costs would be incurred. For engine lines without a highway counterpart, something approaching the $1.6 million tooling cost would be applicable. For this analysis, we have assumed a 50/50 split of engine product lines for highway manufacturers and, therefore, a 50 percent factor applied to the $1.6 million baseline. These tooling costs would be split evenly between NO_X control and PM control. For engine lines <75 horsepower, we have used the same tooling costs as the nonroad-only manufacturers because these engines tend not to have a highway counterpart. Therefore, for those engine lines requiring only a CDPF (*i.e.*, those between 25 and 75 horsepower), we have estimated a tooling cost of $800,000. Similarly, the tooling costs for DOC and/or engine-out engine lines has been estimated to be $400,000. Tooling costs for CDPF-only and for DOC engines are attributed solely to PM control.

We expect engines in the 25 to 50 horsepower range to apply EGR systems to meet the proposed NO_X standards for 2013. For these engines, we have included an additional tooling cost of $40,000 per engine line, consistent with the EGR-related tooling cost estimated for 50–100 horsepower engines in our Tier 2/3 rulemaking. This tooling cost is applied equally to all engine lines in that horsepower range regardless of the markets into which the manufacturer sells. We have applied this tooling cost equally because engines in this horsepower range do not tend to have highway counterparts. Tooling costs for EGR systems are attributed solely to NO_X control.

We have applied all the above tooling costs to all manufacturers that appear to actually make engines. We have not eliminated joint venture manufacturers because these manufacturers would still need to invest in tooling to make the engines even if they do not conduct any R&D. We have assumed that all tooling costs are incurred one year in advance of the new standard and are recovered over a five year period following implementation of the new standard; all tooling costs are marked up seven percent to reflect the time value of money. As done for R&D costs, we have attributed a portion of the tooling costs to U.S. sales and a portion to sales in other countries expected to have similar levels of emission control. More information is contained in Chapter 6 of the draft RIA and we request comment on how we have applied our tooling cost estimates and to whom we have applied them.

Using this methodology, we estimate the total tooling expenditures attributable to the proposed standards at $67 million.

iii. Engine Certification Costs

Manufacturers will incur more than the normal level of certification costs during the first few years of implementation because engines will need to be certified to the new emission standards. Consistent with our recent standard setting regulations, we have estimated engine certification costs at $60,000 per new engine certification to cover testing and administrative costs. To this we have added the proposed certification fee of $2,156 per new engine family. This cost, $62,156 per engine family was used for <75 horsepower engines certifying to the 2008 standards. For 25 to 75 horsepower engines certifying to the 2013 standards, and for >75 horsepower engines certifying to their proposed standards, we have added costs to cover the proposed test procedures for nonroad diesel engines (*i.e.*, the transient test and the NTE); these costs were estimated at $10,500 per engine family. These certification costs—whether it be the $62,156 or the $72,656 per engine family—apply equally to all engine families for all manufacturers regardless of into what markets the manufacturer sells. We have applied these certification costs to only the US sold engines because the certification conducted for US sales is not presumed to fulfill the certification requirements of other countries.

Applying these costs to each of the 665 engine families as they are certified to a new emissions standard results in total costs of $72 million expended during implementation of the proposed standards. These costs are attributed to NO_X and PM control consistent with the phase-in of the new emissions standards—where new NO_X and PM standards are introduced together, the certification costs are split evenly; where only a new PM standard is introduced, the certification costs are attributed to PM only; where a NO_X phase-in becomes 100% in a year after full implementation of a PM standard, the certification costs are attributed to NO_X only. All certification costs are assumed to occur one year prior to the new emission standard and are then recovered over a five year period following compliance with the new standard; all certification costs are marked up seven percent to reflect the time value of money.

b. Engine Variable Costs

This section summarizes the detailed analysis presented in the draft RIA for this proposed rule. We encourage the reader to refer to chapter 6 of that draft RIA for the details of what is presented here and encourage comments and supporting data and/or analysis regarding those details. Of particular interest are comments regarding the costs of precious metals, or platinum group metals (PGM). The PGM costs are a significant fraction of the total costs for aftertreatment devices. For our analysis, we have used the 2002 annual average costs for platinum and rhodium (the two PGMs we expect will be used) because we believe they represent a better estimate of the cost for PGM than other metrics. We request comment on this approach and whether an alternative approach would be more appropriate. Specifically, we request comment regarding the use of a five year average in place of the one year average we have used. Additionally, EPA invites comment on the impacts, if any, that this rulemaking would have in the context of a variety of rulemakings on the market impacts on precious metals.

i. NO_X Adsorber System Costs

The NO_X adsorber system that we are anticipating would be applied for Tier 4 would be the same as that used for highway applications. In order for the NO_X adsorber to function properly, a systems approach that includes a reductant metering system and control of engine A/F ratio is also necessary. Many of the new air handling and electronic system technologies developed in order to meet the Tier 2/3 nonroad engine standards can be applied to accomplish the NO_X adsorber control functions as well. Some additional hardware for exhaust NO_X or O_2 sensing and for fuel metering will likely be required. The cost estimates include a DOC for clean-up of hydrocarbon emissions that occur during NO_X adsorber regeneration events. We have also assumed that warranty costs would increase due to the application of this new hardware. Chapter 6 of the draft RIA contains the details for how we estimated costs associated with the new NO_X control technologies required to meet the proposed Tier 4 emission standards. These costs are estimated to increase engine costs by roughly $670 in the near-term for a 150 horsepower engine, and $2,070 in the near-term for a 500 horsepower engine. In the long-term, we estimate these costs to be $550 and $1,670 for the 150 horsepower and 500 horsepower engines, respectively. Note that we have estimated costs for all engines in all horsepower ranges, and these estimates are presented in detail in the draft RIA. Throughout this discussion of engine and equipment costs, we present costs for a 150 and a 500 horsepower engine for illustrative purposes.

ii. Catalyzed Diesel Particulate Filter (CDPF) Costs

CDPFs can be made from a wide range of filter materials including wire mesh, sintered metals, fibrous media, or ceramic extrusions. The most common material used for CDPFs for heavy-duty diesel engines is cordierite. We have based our cost estimates on the use of silicon carbide (SiC) even though it is more expensive than other filter materials. We request comment on our assumption that SiC will be used in favor of cordierite. We estimate that the CDPF systems will add $780 to engine costs in the near-team for a 150 horsepower engine and $2,770 in the near-term for a 500 horsepower engine. In the long-term, we estimate these CDPF system costs to be $590 and $2,110 for the 150 horsepower and the 500 horsepower engines, respectively.

iii. CDPF Regeneration System Costs

Application of CDPFs in nonroad applications is expected to present challenges beyond those of highway applications. For this reason, we anticipate that some additional hardware beyond the diesel particulate filter itself may be required to ensure that CDPF regeneration occurs. For some engines this may be new fuel control strategies that force regeneration under some circumstances, while in other engines it might involve an exhaust system fuel injector to inject fuel upstream of the CDPF to provide necessary heat for regeneration under some operating conditions. We estimate the near-term costs of a CDPF regeneration system to be $190 for a 150 horsepower engine and $320 for a 500 horsepower engine. In the long-term, we estimate these costs at $140 and $240, respectively.

iv. Closed-Crankcase Ventilation System (CCV) Costs

We are proposing to eliminate the exemption that allows turbo-charged nonroad diesel engines to vent crankcase gases directly to the environment. Such engines are said to have an open crankcase system. We project that this requirement to close the crankcase on turbo-charged engines would force manufacturers to rely on engineered closed crankcase ventilation systems that filter oil from the blow-by gases prior to routing them into either the engine intake or the exhaust system upstream of the CDPF. We have estimated the initial cost of these systems to be roughly $40 for low horsepower engines and up to $100 for very high horsepower engines. These costs are incurred only by turbo-charged engines because today's naturally aspirated engines already have CCV systems.

v. Variable Costs for Engines Below 75 Horsepower and Above 750 Horsepower

This proposal includes standards for engines <25 horsepower that begin in 2008, and two sets of standards for 25 to 75 horsepower engines—one set that begins in 2008 and another that begins in 2013. The 2008 standards for all engines <75 horsepower are of similar stringency and are expected to result in similar technologies (*i.e.*, the addition of a DOC). The 2013 standards for 25 to 75 horsepower engines are considerably more stringent than the 2008 standards and are expected to force the addition of a CDPF along with some other engine hardware to enable the proper functioning of that new technology. More detail on the mix of technologies expected for all engines <75 horsepower is presented in section III. As discussed there, if changes are needed to comply, we expect manufacturers to comply with the 2008 standards through either engine improvements or through the addition of a DOC. From a cost perspective, we have projected that engines would comply by either adding a DOC or by making some engine modifications resulting in engine-out emission reductions. Presumably, the manufacturer would choose the least costly approach that provided the necessary reduction. If engine-out modifications are less costly than a DOC, our estimate here is conservative. If the DOC proves to be less costly, then our estimate is representative of what most manufacturers would do. Therefore, we have assumed that, beginning in 2008, all engines below 75 horsepower add a DOC. Note that this is a conservative estimate in that we have assume this cost for all engines when, as discussed in section IV, some engines <75 horsepower already meet the proposed PM standards. We have estimated this added hardware to result in an increased engine cost of $150 in the near-term and $140 in the long-term for a 30 horsepower engine.

We have also projected that some engines in the 25 to 75 horsepower range would have to upgrade their fuel systems to accommodate the CDPF. We have estimated the incremental costs for these fuel systems at roughly $740 in the 25–50 horsepower range, and around $430 in the 50–75 horsepower range. This difference reflects a different base fuel system, with the smaller engines assumed to have mechanical fuel systems and the larger engines assumed to already be electronic. The electronic systems will incur lower costs because they already have the control unit and electronic fuel pump. Also, we have assumed these fuel changes would occur for only direct injection (DI) engines; indirect injection engines (IDI) are assumed to remain IDI but to add more hardware as part of their CDPF regeneration system to ensure proper regeneration under all operating conditions. Such a regeneration system, described above, is expected to cost roughly twice that expected for DI engines, or around $320 for a 30 horsepower IDI engine versus $160 for a DI engine.

We have also projected that engines in the 25–50 horsepower range would add cooled EGR to comply with their new NO_X standard. We have estimated that this would add $90 in the near-term and $70 in the long-term to the cost of a 30 horsepower engine.

We believe there are factors that would cause variable hardware costs to decrease over time, making it appropriate to distinguish between near-term and long-term costs. Research in the costs of manufacturing has consistently shown that as manufacturers gain experience in production, they are able to apply innovations to simplify machining and assembly operations, use lower cost materials, and reduce the number or complexity of component parts.[289] Our analysis, as described in more detail in the draft RIA, incorporates the effects of this learning curve by projecting that the variable costs of producing the low-emitting engines decreases by 20 percent starting with the third year of production. For this analysis, we have assumed a baseline that represents such learning already having occurred once due to the 2007 highway rule (*i.e.*, a 20 percent reduction in emission control device costs is reflected in our near-term costs). We have then applied a single learning step from that point in this analysis. We invite comment on this methodology to account for the learning curve phenomenon and also request comment on whether learning is likely to reduce costs even further in this industry (*e.g.*, should a second learning step be applied to our near-term costs?). Additionally, manufacturers are expected to apply ongoing research to make emission controls more effective and to have lower operating costs over time. However, because of the uncertainty involved in forecasting the results of this research, we conservatively have not accounted for it in this analysis.

c. Engine Operating Costs

We are projecting that a variety of new technologies will be introduced to enable nonroad engines to meet the proposed Tier 4 emissions standards. Primary among these are advanced emission control technologies and low-sulfur diesel fuel. The technology enabling benefits of low-sulfur diesel fuel are described in section III, and the incremental cost for low-sulfur fuel is described in section V.A. The new emission control technologies are themselves expected to introduce additional operating costs in the form of increased fuel consumption and increased maintenance demands. Operating costs are estimated in the draft RIA over the life of the engine and are expressed in terms of cents/gallon of fuel consumed. In section V.C.3, we present these lifetime operating costs as a net present value (NPV) in 2001 dollars for several example pieces of equipment.

Total operating cost estimates include the following elements: the change in maintenance costs associated with applying new emission controls to the engines; the change in maintenance costs associated with low sulfur fuel such as extended oil change intervals; the change in fuel costs associated with the incrementally higher costs for low sulfur fuel, and the change in fuel costs due to any fuel consumption impacts associated with applying new emission controls to the engines. This latter cost is attributed to the CDPF and its need for periodic regeneration which we estimate may result in a one percent fuel consumption increase where a NO_X

[289] "Learning Curves in Manufacturing," Linda Argote and Dennis Epple, Science, February 23, 1990, Vol. 247, pp. 920–924.

adsorber is also applied, or a two percent fuel consumption increase where no NO_X adsorber is applied (refer to chapter 6, section 6.2.3.3). Maintenance costs associated with the new emission controls on the engines are expected to increase since these devices represent new hardware and, therefore, new maintenance demands. For CDPF maintenance, we have used a maintenance interval of 3,000 hours for smaller engines and 4,500 hours for larger engines and a cost of $65 through $260 for each maintenance event. For closed-crankcase ventilation (CCV) systems, we have used a maintenance interval of 675 hours for all engines and a cost per maintenance event of $8 to $48 for small to large engines. Offsetting these maintenance cost increases would be a savings due to an expected increase in oil change intervals because low sulfur fuel would be far less corrosive than is current nonroad diesel fuel. Less corrosion would mean a slower acidification rate (*i.e.*, less degradation) of the engine lubricating oil and, therefore, more operating hours between needed oil changes. As discussed in section V.B, the use of 15 ppm sulfur fuel can extend oil change intervals by as much as 35 percent for both new and existing nonroad engines and equipment. We have used a 35 percent increase in oil change interval along with costs per oil change of $70 through $400 to arrive at estimated savings associated with increased oil change intervals.

These operating costs are expressed as a cent/gallon cost (or savings). As a result, operating costs are directly proportional to the amount of fuel consumed by the engine. We have estimated these operating costs, inclusive of fuel-related costs, to be 3.4 cents/gallon for a 150 horsepower engine and 4.2 cents/gallon for a 500 horsepower engine. More detail on operating costs can be found in chapter 6 of the draft RIA.

The existing fleet will also benefit from lower maintenance costs due to the use of low sulfur diesel fuel. The operating costs for the existing fleet are discussed in Section V.B.

2. Equipment Cost Impacts

In addition to the costs directly associated with engines that incorporate new emission controls to meet new standards, we expect cost increases due to the need to redesign the nonroad equipment in which these engines are used. Such redesigns would probably be necessary due to the expected addition of new emission control systems, but could also occur if the engine has a different shape or heat rejection rate, or is no longer made available in the configuration previously used. Based on their past experiences, equipment manufacturers have told EPA that a major concern with a new standard is their ability to redesign a large number of applications in a short period of time. Therefore, we have provided equipment manufacturers transition flexibility provisions to help them avoid business disruptions resulting from the changes associated with new emission standards. These flexibility provisions are presented in detail in Section III.E.4.

In assessing the economic impact of the new emission standards, EPA has made a best estimate of the modifications to equipment that relate to packaging (installing engines in equipment engine compartments). The incremental costs for new equipment would be comprised of fixed costs (for redesign to accommodate new emission control devices) and variable costs (for new equipment hardware and for labor to install new emission control devices). Note that the fixed costs do not include certification costs, as did the engine fixed costs, because equipment is not certified to emission standards. We have attributed all changes in operating costs (*e.g.*, additional maintenance) to the cost estimates for engines. Included in section V.C.3 is a discussion of several example pieces of equipment (*e.g.*, skid/steer loader, dozer, etc.) and the costs we have estimated for these specific example pieces of equipment. Full details of our equipment cost analysis can be found in chapter 6 of the draft RIA. All costs are presented in 2001 dollars.

a. Equipment Fixed Costs

The most significant changes anticipated for equipment redesign are changes to accommodate the physical changes to engines, especially for those engines that add PM traps and NO_X adsorbers. The costs for engine development and the emission control devices are included as costs to the engines, as described above. *What remains to be quantified for equipment manufacturers is the effort to integrate the engine and emissions control devices into the overall functioning of the equipment.* What remains to be quantified for equipment manufacturers is the effort to integrate the engine and emissions control devices into the overall functioning of the equipment. We have allocated extensive engineering time for this effort.

The costs we have estimated are based on engine power and whether an application is non-motive (*e.g.*, a generator set) or motive (*e.g.*, a skid steer loader). The designs we have considered to be non-motive are those that lack a propulsion system. In addition, the proposed emission standards for engines rated under 25 horsepower and the proposed 2008 standards for 25–75 horsepower engines are projected to require no significant equipment redesign beyond that done to accommodate the Tier 2 standards. We expect that these engines would comply with the proposesd Tier 4 standards through either engine modifications to reduce engine-out emissions or through the addition of a DOC. We have projected that engine modifications would not affect the outer dimensions of the engine and that a DOC would replace the existing muffler. Therefore, either approach taken by the engine manufacturer should have minimal to no impact on the equipment design. Nonetheless, we have conservatively estimated their redesign costs at $50,000 per model.

A number of equipment manufacturers have shared detailed information with us regarding the investments made for Nonroad Tier 2 equipment redesign efforts, as well as redesign estimates for significant changes such as installing a new engine design. These estimates range from approximately $50,000 for some lower powered equipment models to well over $1 million dollars for high horsepower equipment with very challenging design constraints. Based on that input, for the proposed Tier 4 standards, we have estimated that equipment redesign costs would range from $50,000 per model for 25 horsepower equipment up to $750,000 per model for 300 horsepower equipment and above. We have attributed only a portion of the equipment redesign costs to U.S. sales in a manner consistent with that taken for engine R&D costs and engine tooling costs. In addition, we expect manufacturers to incur some fixed costs to update service and operation manuals to address the maintenance demands of new emission control technologies and the new oil service intervals which we estimate to be between $2,500 and $10,000 per equipment model.

These equipment fixed costs (redesign and manual updates) were then allocated appropriately to each new model to arrive at a total equipment fixed cost of $697 million. We have assumed that these costs would be recovered over a ten year period at a seven percent interest rate.

b. Equipment Variable Costs

Equipment variable cost estimates are based on costs for additional materials to mount the new hardware (*i.e.*, brackets and bolts required to secure the aftertreatment devices) and additional sheet metal assuming that the body cladding of a piece of equipment (*i.e.*, the hood) might change to accommodate the aftertreatment system. Variable costs also include the labor required to install these new pieces of hardware. For engines >75 horsepower—those expected to incorporate CDPF and NO_X adsorber technology—the amount of sheet metal is based on the size of the aftertreatment devices.

For equipment of 150 horsepower and 500 horsepower, respectively, we have estimated the costs to be roughly $60 to $140. Note that we have estimated costs for equipment in all horsepower ranges, and these estimates are presented in detail in the draft RIA. Throughout this discussion of engine and equipment costs, we present costs for a 150 and a 500 horsepower engine for illustrative purposes.

3. Overall Engine and Equipment Cost Impacts

To illustrate the engine and equipment cost impacts we are estimating for the proposed standards, we have chosen several example pieces of equipment and presented the estimated costs for them. Using these examples, we can calculate the costs for a specific piece of equipment in several horsepower ranges and better illustrate the cost impacts of the proposed standards. These costs along with information about each example piece of equipment are shown in Table V.C–1. Costs presented are near-term and long-term costs for the final standards to which each piece of equipment would comply. Long-term costs are only variable costs and, therefore, represent costs after all fixed costs have been recovered and all projected learning has taken place. Included in the table are estimated prices for each piece of equipment to provide some perspective on how our estimated control costs relate to existing equipment prices.

TABLE V.C–1—NEAR-TERM AND LONG-TERM COSTS FOR SEVERAL EXAMPLE PIECES OF EQUIPMENT[a]

($2001, for the final emission standards to which the equipment must comply)

	GenSet	Skid/steer loader	Backhoe	Dozer	Ag tractor	Dozer	Off-highway truck
Horsepower	9 hp	33 hp	76 hp	175 hp	250 hp	503 hp	1,000 hp
Incremental engine & equipment cost							
Long-term	$120	$760	$1,210	$2,590	$2,000	$4,210	$6,780
Near-term	$170	$1,100	$1,680	3,710	$2,950	$6,120	$10,100
Estimated equipment price when new[b]	$3,500	$13,500	$50,000	$235,000	$130,000	$575,000	$700,000
Incremental operating costs[c]	−$90	$40	$370	$1,550	$1,320	$4,950	$12,550
Baseline operating costs (fuel & oil only)[c]	$940	$2,680	$7,960	$77,850	$23,750	$77,850	$179,530

Notes:

[a] Near-term costs include both variable costs and fixed costs; long-term costs include only variable costs and represent those costs that remain following recovery of all fixed costs.

[b] ''Estimated Price of New Nonroad Example Equipment,'' memorandum from Zuimdie Guerra to docket A–2001–28.

[c] Present value of lifetime costs.

More detail and discussion regarding what these costs and prices mean from an economic impact perspective can be found in section V.E.

D. Annual Costs and Cost Per Ton

One tool that can be used to assess the value of the proposed standards for nonroad fuel and engines is the costs incurred per ton of emissions reduced. This analysis involves a comparison of our proposed program to other measures that have been or could be implemented.

We have calculated the cost per ton of our proposed program based on the net present value of all costs incurred and all emission reductions generated over a 30 year time window following implementation of the program. This approach captures all of the costs and emissions reductions from our proposed program including those costs incurred and emissions reductions generated by the existing fleet. The baseline (*i.e.*, the point of comparison) for this evaluation is the existing set of fuel and engine standards (*i.e.*, unregulated fuel and the Tier 2/Tier 3 program). The 30 year time window chosen is meant to capture both the early period of the program when very few new engines that meet the proposed standards would be in the fleet, and the later period when essentially all engines would meet the proposed standards.

As discussed in section IV, the proposal contains two separate fuel programs. We are proposing a 500 ppm sulfur cap on nonroad, locomotive, and marine fuels beginning in 2007. This fuel program, the first step in our two step fuel program, provides significant air quality benefits through reduced SO_2 and PM emissions from both new and existing nonroad, locomotive, and marine engines. In sections V.D.1 and 2, we summarize the cost for this program as if it remained in place for 30 years, even though it would be supplanted by the second step of our fuel program in 2010. We also provide an analysis of the cost per ton for the SO_2 reductions that would be realized by the 500 ppm fuel program for the same 30 year time window. In this way, the cost per ton of the SO_2 reductions realized by the 500 ppm fuel program can be compared to other available means to control SO_2 emissions. The significant PM reductions are not accounted for in the relative cost per ton estimate, but are accounted for in our inventory analysis presented in section II and in the benefits analysis presented later in this section. Additional detail regarding all of the estimates presented here are available in the draft RIA.

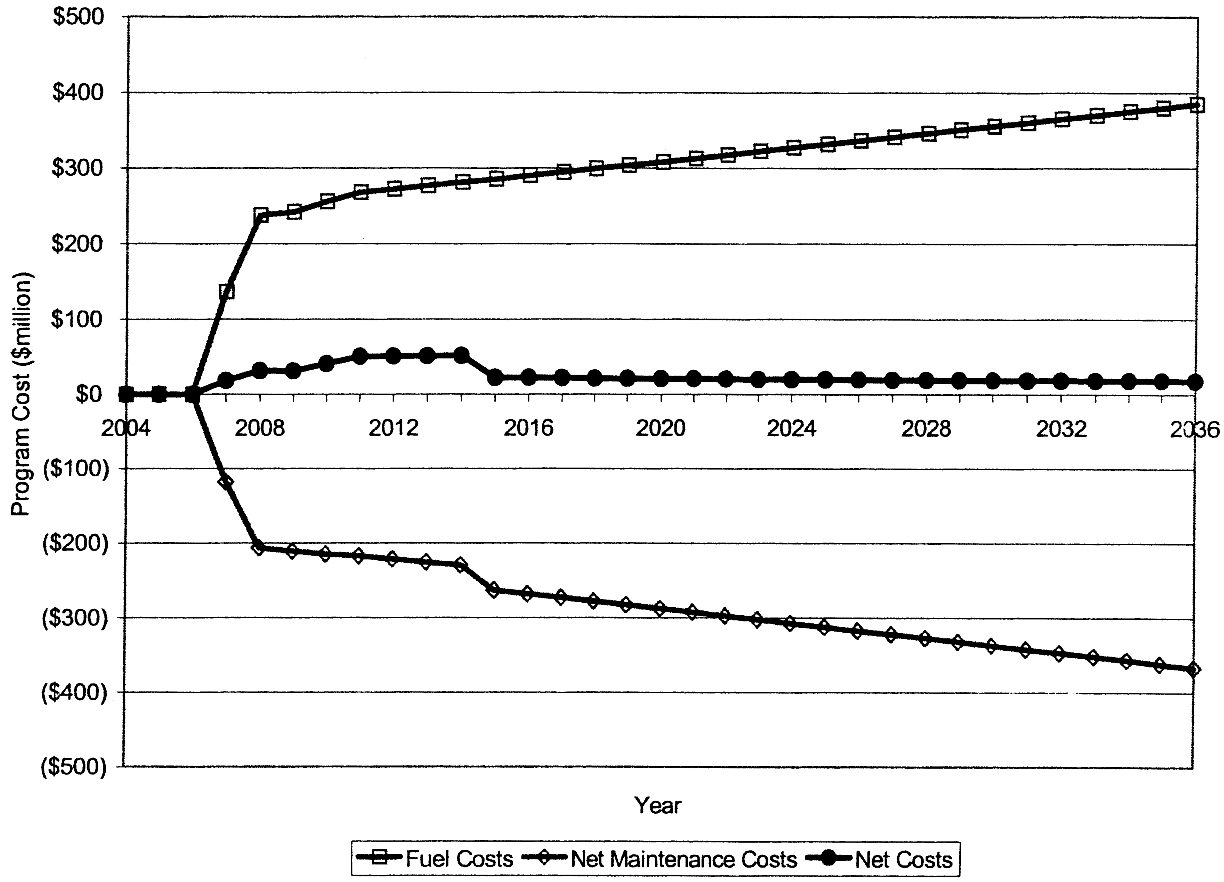
We are proposing a second step in the fuel program that would cap nonroad fuel sulfur levels at 15 ppm beginning in 2010. This fuel program enables the introduction of advanced emission control technologies including CDPFs and NO_X adsorbers. The combination of the two-step fuel program and the new diesel engine standards represents the total Tier 4 program for nonroad diesel engines and fuel proposed today. In sections V.D.3 and 4, we present our estimate of the annual and total costs for this complete program beginning in 2007 and continuing for 30 years. Also included is an estimate of the cost per ton of emissions reductions realized by this program for NMHC+NO_X, PM, and SO_2.

1. Annual Costs for the 500 ppm Fuel Program

Cent per gallon costs for the proposed 500 ppm fuel program (*i.e.*, the reduction to a 500 ppm sulfur cap) were presented in section V.A. Having this fuel would result in maintenance savings associated with increased oil change intervals for both the new and the existing fleet of nonroad, locomotive, and marine engines. These maintenance savings were discussed in section V.B. There are no engine and equipment costs associated with the 500 ppm fuel program because new emission standards are not part of that proposed program. Figure V.D–1 shows the annual costs associated with the 500 ppm fuel program.

As can be seen in Figure V.D–1, the costs for refining and distributing the 500 ppm fuel range from $250 million in 2008 to nearly $400 million in 2036. These control costs are largely offset by the maintenance savings that range from $200 million in 2008 to $380 million in 2036. Despite the fact that the costs of the 500 ppm fuel for nonroad diesel fuel is 2.5 cents/gallon and the maintenance savings are 3 cents per gallon, the net costs are positive because of the costs for the locomotive and marine fuel is not off-set by the maintenance savings. As a whole, the net cost of the program in each year is essentially zero, ranging from $50 million in the early years to only $18 million in 2036. The net present value of the net costs and savings associated with the proposed 500 ppm fuel program during the years 2007 to 2036 is estimated at $510 million.

FIGURE V.D-1 -- ANNUAL COSTS OF THE 500 PPM FUEL PROGRAM



2. Cost Per Ton for the 500 ppm Fuel Program

The 2007 fuel program would result in large reductions of both SO_2 and PM emissions. Roughly 98 percent of fuel sulfur is converted to SO_2 in the engine with the remaining two percent being exhausted as sulfate PM. Because the majority of the emissions reductions associated with this program would be SO_X, we have attributed all the control costs to SO_X in calculating the cost per ton associated with this program. However, we have modeled both the SO_X and PM reductions so that our inventory and benefits analysis fully account for them.

As noted above, we have calculated both the costs and emission reductions of the 500 ppm fuel program as if it were to remain in place indefinitely. Figure V.D–1 shows the costs in each year of the program, the net present value of which is estimated at $510 million. We have estimated the 30 year net present value of the SO_X emission reductions at 5.6 million tons.

Table V.D–1 shows the cost per ton of emissions reduced as a result of the proposed 500 ppm fuel program. The cost per ton numbers include costs and emission reductions that would occur from both the new and the existing fleet (*i.e.*, those pieces of nonroad equipment that were sold into the market prior to the proposed emission standards) of nonroad, locomotive, and marine engines.

TABLE V.D–1—500 PPM FUEL PROGRAM AGGREGATE COST PER TON AND LONG-TERM ANNUAL COST PER TON ($2001)

Pollutant	2004–2036 Discounted lifetime cost per ton	Long-term cost per ton in 2036
SO_X	$90	$50

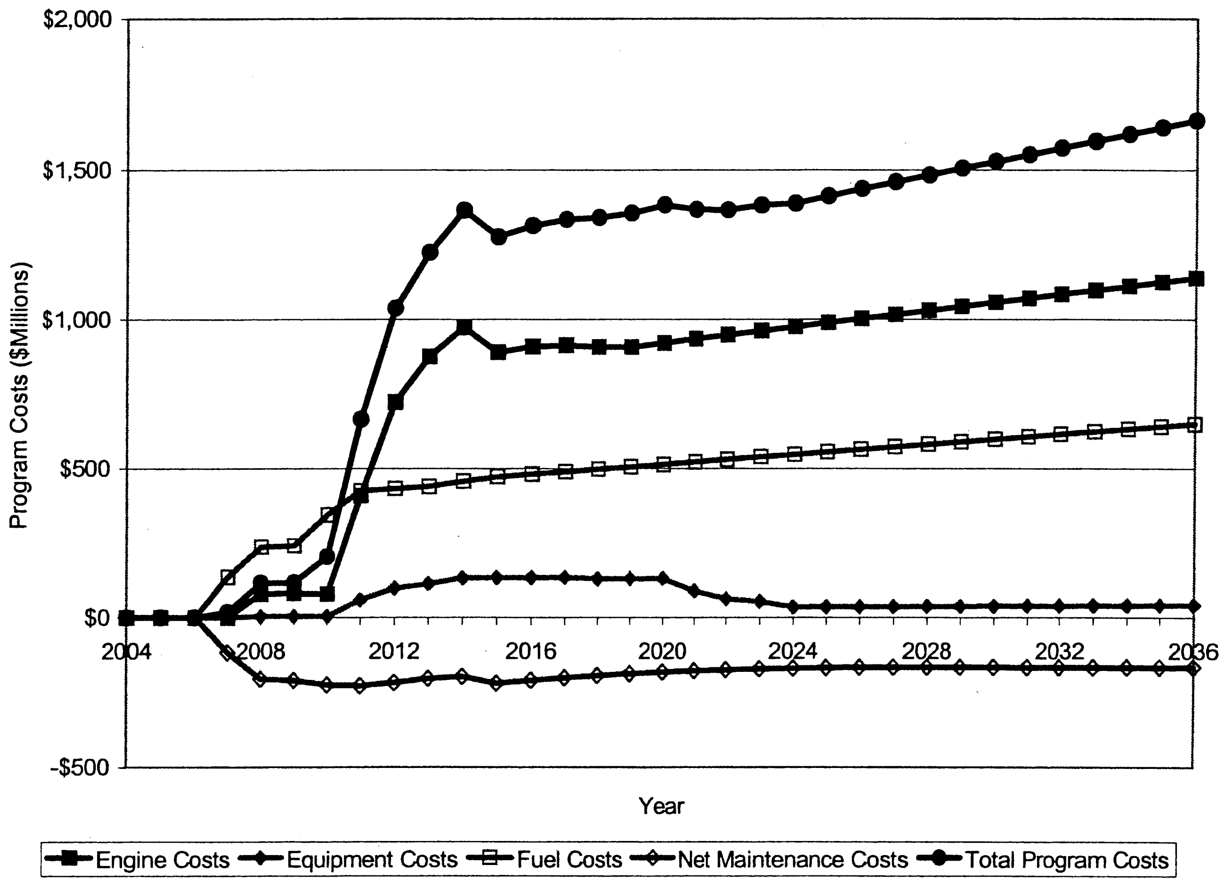
We also considered the cost per ton of the 500 ppm fuel program without taking credit for the expected maintenance savings associated with low sulfur fuel. Without the maintenance savings, the cost per ton of SO_X reduced would be $990 per ton for each year of the program. More detail on how the costs and cost per ton numbers associated with the 500 ppm fuel program were calculated can be found in the draft RIA.

3. Annual Costs for the Proposed Two-Step Fuel Program and Engine Program

The costs of the total proposed engine and fuel program include costs associated with both steps in the fuel program—the reduction to 500 ppm sulfur in 2007 and the reduction to 15 ppm sulfur in 2010. Also included are costs for the proposed 2008 engine standards for <75 horsepower engines, the proposed 2013 standards for 25 to 75 horsepower engines, and costs for the proposed engine standards for >75 horsepower engines. Included are all maintenance costs and savings realized by both the existing fleet (nonroad, locomotive, and marine) and the new fleet of engines complying with the proposed standards.

Figure V.D–2 presents these results. All capital costs for fuel production and engine and equipment fixed costs have been amortized. The figure shows that total annual costs are estimated to be $120 million in the first year the new engine standards apply, increasing to a peak of $1.7 billion in 2036 as increasing numbers of engines become subject to the new standards and an ever increasing amount of fuel is consumed. The net present value of the annualized costs over the period from 2007 to 2036 is $20.7 billion.

FIGURE V.D-2 -- ANNUAL COSTS OF THE PROPOSED TWO-STEP FUEL AND ENGINE PROGRAM



4. Cost per Ton of Emissions Reduced for the Total Program

We have calculated the cost per ton of emissions reduced associated with the proposed engine and fuel program. We have done this using the net present value of the annualized costs of the program through 2036 and the net present value of the annual emission reductions through 2036. We have also calculated the cost per ton of emissions in the year 2036 using the annual costs and emission reductions in that year alone. This number represents the long-term cost per ton of emissions reduced after all fixed costs of the program have been recovered by industry leaving only the variable costs of control. The cost per ton numbers include costs and emission reductions that would occur from the existing fleet (*i.e.*, those pieces of nonroad equipment that were sold into the market prior to the proposed emission standards). These results are shown in Table V.D–2. We did the cost analysis using a 3% discount rate. We will also be conducting a similar analysis using a 7% discount rate and including this information in the docket.

TABLE V.D–2—TOTAL PROPOSED FUEL AND ENGINE PROGRAM AGGREGATE COST PER TON AND LONG-TERM ANNUAL COST PER TON ($2001)

Pollutant	2004–2036 Discounted lifetime cost per ton	Long-term cost per ton in 2036
NO_X+NMHC	$810	$530
PM	8,700	6,900
SO_X	[a] 200	170

Notes:
[a] This result does not match that in Table 8.4–2 because the nonroad portion of the fuel is reduced to 15 ppm and does not stay at 500 (locomotive and marine portions are kept at 500ppm). The costs to reduce fuel sulfur from uncontrolled to 15ppm were assigned 50/50 to NO_X+NMHC and PM for the reduction to 15 ppm is to enable aftertreatment technology.

5. Comparison With Other Means of Reducing Emissions

In comparison with other programs to control these pollutants, we believe that the proposed programs represent a cost effective strategy for generating substantial NO_X+NMHC, PM, and SO_2 reductions. This can be seen by comparing the 2007 fuel program (*i.e.*, a sulfur cap of 500 ppm) cost per ton and the total program cost per ton with a number of standards that EPA has adopted in the past. Table V.D–3 summarizes the cost per ton of several past EPA actions for NO_X+NMHC. Table V.D–4 summarizes the cost per ton of several past EPA actions for PM.

TABLE V.D–3—COST PER TON OF PREVIOUS MOBILE SOURCE PROGRAMS FOR NO_X + NMHC

Program	$/ton
Tier 2 Nonroad Diesel	630
Tier 3 Nonroad Diesel	430
Tier 2 vehicle/gasoline sulfur	1,410–2,370
2007 Highway HD	2,260
2004 Highway HD	220–430
Off-highway diesel engine	450–710
Tier 1 vehicle	2,160–2,930
NLEV	2030
Marine SI engines	1,230–1,940
On-board diagnostics	2,430
Marine CI engines	30–190

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

TABLE V.D–4.—COST PER TON OF PREVIOUS MOBILE SOURCE PROGRAMS FOR PM

Program	$/ton
Tier 1/Tier 2 Nonroad Diesel	2,410
2007 Highway HD	14,280
Marine CI engines	5,480–4,070
1996 urban bus	12,870–20,590
Urban bus retrofit/rebuild	31,740
1994 highway HD diesel	21,930–25,670

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

To compare the cost per ton of SO_2 emissions reduced, we looked at the cost per ton for the Title IV SO_2 trading programs. This information is found in EPA report 430/R–02–004, ‘‘Documentation of EPA Modeling Applications (V.2.1) Using the Integrated Planning Model’’, in Figure 9.11 on page 9–14 (*www.epa.gov/airmarkets/epa-ipm/index.html#documentation*). The SO_2 cost per ton results of the proposed program presented in Table V.D–2 compare very favorably with the program shown in Table V.D–5.

TABLE V.D–5—COST PER TON OF SO_2 FROM EPA BASE CASE 2000 FOR THE TITLE IV SO_2 TRADING PROGRAMS

Program	$/ton
Title IV SO_2 Trading Programs.	$490 in 2010 to $610 in 2020.

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

E. Do the Benefits Outweigh the Costs of the Standards?

Our analysis of the health and welfare benefits to be expected from this proposal are presented in this section. Briefly, the analysis projects major benefits throughout the period from initial implementation of the rule through 2030, the last year analyzed. As described below, thousands of deaths and other serious health effects would be prevented, yielding a net present value in 2004 of those benefits we could monetize of approximately $550 billion dollars. These benefits exceed the net present value of the social cost of the proposal ($17 billion) by a factor of over 30 to one.

1. What Were the Results of the Benefit-Cost Analysis?

Table V.E–1 presents the primary estimate of reduced incidence of PM-related health effects for the years 2020 and 2030. In interpreting the results, it is important to keep in mind the limited set of effects we are able to monetize. Specifically, the table lists the PM-related benefits associated with the reduction of several health effects.[290] In 2030, we estimate that there will be 9,600 fewer fatalities per year associated with fine PM, and the rule will result in about 5,700 fewer cases of chronic bronchitis, 8,300 fewer hospitalizations (for respiratory and cardiovascular disease combined), and result in significant reductions in days of restricted activity due to respiratory illness (with an estimated 5.7 million fewer cases). We also estimate substantial health improvements for children from reduced upper and lower respiratory illness, acute bronchitis, and asthma attacks.[291]

Table V.E–2 presents the total monetized benefits for the years 2020 and 2030. This table also indicates with a ‘‘B’’ those additional health and environmental effects which we were unable to quantify or monetize. These effects are additive to estimate of total benefits, and EPA believes there is

[290] Based upon recent preliminary findings by the Health Effects Institute, the concentration-response functions used to estimate reductions in hospital admissions may over or underestimate the true concentration-response relationship. *See* letter from Dan Greenberg, President, Health Effects Institute, May 30, 2002, attached to letter from Dr. Hopke, dated August 8, 2002. Docket A–2000–01, Document IV–A–145.

[291] Our estimate incorporates significant reductions of 150,000 fewer cases of lower respiratory symptoms in children ages 7 to 14 each year, 110,000 fewer cases of upper respiratory symptoms (similar to cold symptoms) in asthmatic children each year, and 14,000 fewer cases of acute bronchitis in children ages 8 to 12 each year. In addition, we estimate that this rule will reduce almost 6,000 emergency room visits for asthma attacks in children each year from reduced exposure to particles. Additional incidents would be avoided from reduced ozone exposures. Asthma is the most prevalent chronic disease among children and currently affects over seven percent of children under 18 years of age.

considerable value to the public of the benefits that could not be monetized. A full listing of the benefit categories that could not be quantified or monetized in our estimate are provided in Table V.E–5.

In summary, EPA's primary estimate of the benefits of the rule are approximately $81 + B billion in 2030. In 2020, total monetized benefits are approximately $43 + B billion. These estimates account for growth in real gross domestic product (GDP) per capita between the present and the years 2020 and 2030. As the table indicates, total benefits are driven primarily by the reduction in premature fatalities each year, which account for over 90 percent of total benefits.

TABLE V.E–1.—REDUCTIONS IN INCIDENCE OF PM-RELATED ADVERSE HEALTH EFFECTS ASSOCIATED WITH THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

Endpoint	Avoided incidence [a] (cases/year)	
	2020	2030
Premature mortality [b]—Base estimate: Long-term exposure (adults, 30 and over)	5,200	9,600
Chronic bronchitis (adults, 26 and over)	3,600	5,700
Non-fatal myocardial infarctions (adults, 18 and older)	9,200	16,000
Hospital admissions—Respiratory (adults, 20 and older) [c]	2,400	4,500
Hospital admissions—Cardiovascular (adults, 20 and older) [d]	1,900	3,800
Emergency Room Visits for Asthma (18 and younger)	3,600	5,700
Acute bronchitis (children, 8–12)	8,400	14,000
Lower respiratory symptoms (children, 7–14)	92,000	150,000
Upper respiratory symptoms (asthmatic children, 9–11)	77,000	110,000
Work loss days (adults, 18–65)	650,000	960,000
Minor restricted activity days (adults, age 18–65)	3,900,000	5,700,000

Notes:

[a] Incidences are rounded to two significant digits.

[b] Premature mortality associated with ozone is not separately included in this analysis

[c] Respiratory hospital admissions for PM includes admissions for COPD, pneumonia, and asthma.

[d] Cardiovascular hospital admissions for PM includes total cardiovascular and subcategories for ischemic heart disease, dysrhythmias, and heart failure.

TABLE V.E–2.—EPA PRIMARY ESTIMATE OF THE ANNUAL QUANTIFIED AND MONETIZED BENEFITS ASSOCIATED WITH IMPROVED PM AIR QUALITY RESULTING FROM THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

Endpoint	Monetary Benefits[a, b] (millions 2000$, adjusted for income growth)	
	2020	2030
Premature mortality [c] Long-term exposure (adults, 30 and over)	$39,000	$74,000
Chronic bronchitis (WTP valuation; adults, 26 and over)	1,600	2,600
Non-fatal myocardial infarctions	750	1,300
Hospital Admissions from Respiratory Causes [d]	38	74
Hospital Admissions from Cardiovascular Causes [e]	40	80
Emergency Room Visits for Asthma	1	2
Acute bronchitis (children, 8–12)	3	5
Lower respiratory symptoms (children, 7–14)	2	3
Upper respiratory symptoms (asthmatic children, 9–11)	2	3
Work loss days (adults, 18–65)	90	130
Minor restricted activity days (adults, age 18–65)	210	320
Recreational visibility (86 Class I Areas)	1,200	1,900
Total Monetized Benefits [f]	43,000 + B	81,000 + B

Notes:

[a] Monetary benefits are rounded to two significant digits.

[b] Monetary benefits are adjusted to account for growth in real GDP per capita between 1990 and the analysis year (2020 or 2030).

[c] Valuation assumes the 5 year distributed lag structure described earlier. Results reflect the use of two different discount rates; a 3% rate which is recommended by EPA's Guidelines for Preparing Economic Analyses (US EPA, 2000a), and 7% which is recommended by OMB Circular A–94 (OMB, 1992).

[d] Respiratory hospital admissions for PM includes admissions for COPD, pneumonia, and asthma.

[e] Cardiovascular hospital admissions for PM includes total cardiovascular and subcategories for ischemic heart disease, dysrhythmias, and heart failure.

[f] B represents the monetary value of the unmonetized health and welfare benefits. A detailed listing of unquantified PM, ozone, CO, and NMHC related health effects is provided in Table V.E–5.

The estimated social cost (measured as changes in consumer and producer surplus) in 2030 to implement the final rule from Table V.F–2 is $1.5 billion (2000$). Thus, the net benefit (social benefits minus social costs) of the program at full implementation is approximately $79 + B billion. In 2020, partial implementation of the program yields net benefits of $42 + B billion. Therefore, implementation of the final rule is expected to provide society with a net gain in social welfare based on economic efficiency criteria. Table V.E–3 presents a summary of the benefits, costs, and net benefits of the proposed rule. Figure VE.1 displays the stream of benefits, costs, and net benefits of the Nonroad Land-based Diesel Vehicle Rule from 2007 to 2030. In addition, Table V–E.4 presents the net present value of the stream of benefits, costs, and net benefits associated with the rule for this 23 year period (using a three percent discount rate). The total net present value in 2004 of the stream of net benefits (benefits minus costs) is $530 billion.

TABLE V.E–3.—SUMMARY OF BENEFITS, COSTS, AND NET BENEFITS OF THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

	2020 [a] (billions of 2000 dollars)	2030 [a] (billions of 2000 dollars)
Social Costs [b]	$1.4	$1.5.
Social Benefits [b, c, d]:		
CO, VOC, Air Toxic-related benefits	Not monetized	Not monetized.
Ozone-related benefits	Not monetized	Not monetized.
PM-related Welfare benefits	$1.2	$1.9.
PM-related Health benefits	$42+ B	$79 + B.
Net Benefits (Benefits-Costs) [c]	$42 + B	$79 + B.

Notes:

[a] All costs and benefits are rounded to two significant digits.

[b] Note that costs are the total costs of reducing all pollutants, including CO, VOCs and air toxics, as well as NO_X and PM. Benefits in this table are associated only with PM, NO_X and SO_3 reductions.

[c] Not all possible benefits or disbenefits are quantified and monetized in this analysis. Potential benefit categories that have not been quantified and monetized are listed in Table V.E–5. B is the sum of all unquantified benefits and disbenefits.

FIGURE V.E-1 -- STREAM OF BENEFITS, COSTS, AND NET BENEFITS OF THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

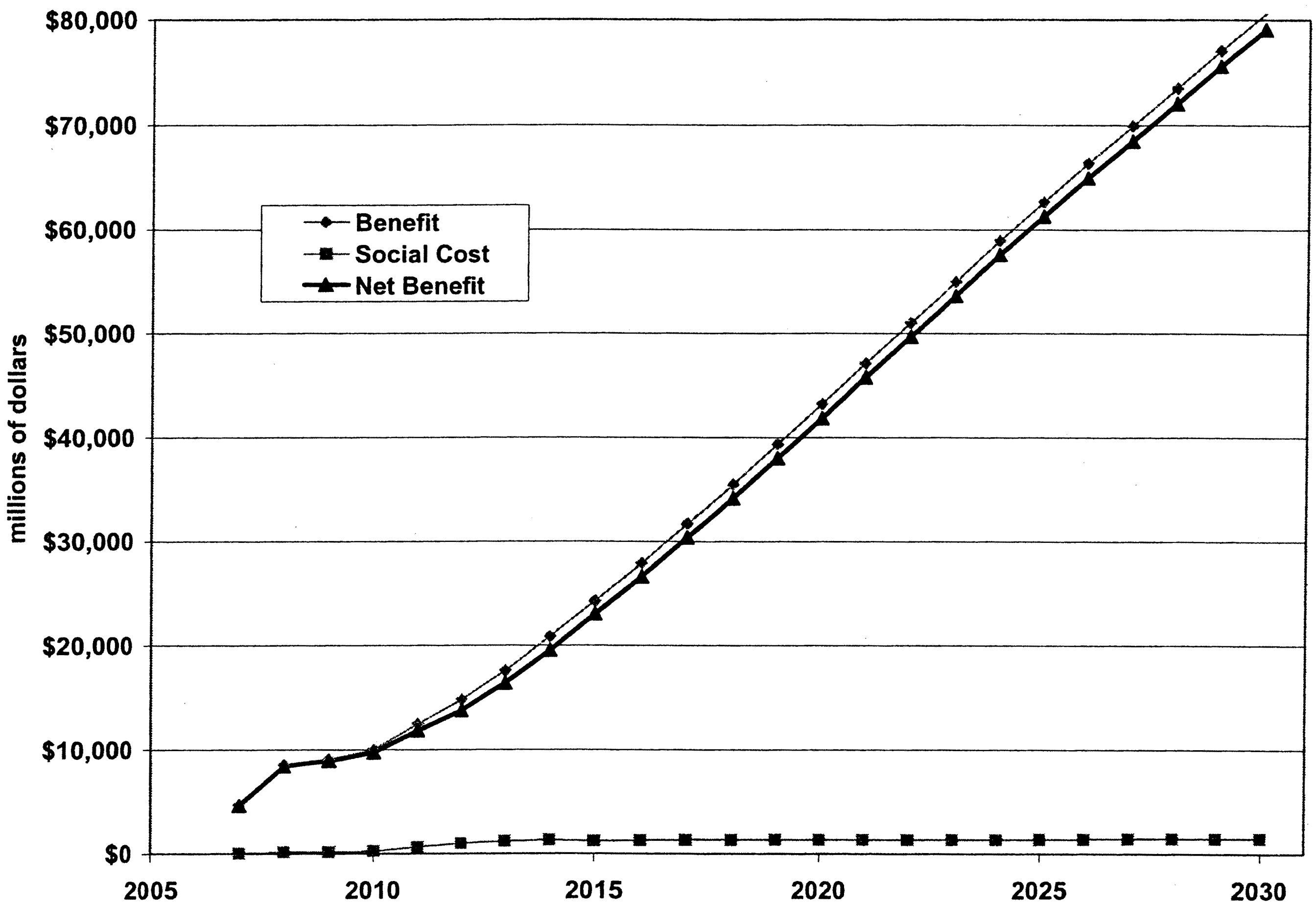


TABLE V.E–4.—NET PRESENT VALUE IN 2004 OF THE STREAM OF BENEFITS, COSTS, AND NET BENEFITS FOR THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

[Billions of 2000$]

Social Costs	$17
Social Benefits	550
Net Benefits	[a] 530

Notes:

[a] Numbers do not add due to rounding.

2. What Was Our Overall Approach to the Benefit-Cost Analysis?

The basic question we sought to answer in the benefit-cost analysis was, ''What are the net yearly economic benefits to society of the reduction in mobile source emissions likely to be achieved by this proposed rulemaking?'' In designing an analysis to address this question, we selected two future years for analysis (2020 and 2030) that are representative of the stream of benefits and costs at partial and full-implementation of the program.

To quantify benefits, we evaluated PM-related health effects (including directly emitted PM, SO_3, and NO_X contributions to fine particulate matter). Our approach requires the estimation of changes in air quality expected from the rule and then estimating the resulting impact on health. In order to characterize the benefits of today's action, given the constraints on time and resources available for the analysis, we adopted a benefits transfer technique that relies on air quality and benefits modeling for a preliminary control option for nonroad diesel engines and fuels. Results from the modeled preliminary control option in 2020 and 2030 are then scaled and transferred to the emission reductions expected from the proposed rule. We also transferred modeled results by using scaling factors associated with time to examine the stream of benefits in years other than 2020 and 2030.

More specifically, our health benefits assessment is conducted in two phases. Due to the time requirements for running the sophisticated emissions and air quality models needed to obtain estimates of the benefits expected to result from implementation of the rule, it is often necessary to select an example set of emission reductions to use for the purposes of emissions and air quality modeling. In phase one, we evaluate the PM and ozone related health effects associated with a modeled preliminary control option that was a close approximation of the proposed standards in the years 2020 and 2030. Using information from the modeled preliminary control option on the changes in ambient concentrations of PM and ozone, we then conduct a health assessment to estimate the number of reduced incidences of illnesses, hospitalizations, and premature fatalities associated with this scenario and estimate the total economic value of these health benefits. The standards we are proposing in this rulemaking, however, are slightly different in the amount of emission reductions expected to be achieved in 2020 and 2030 relative to the modeled scenario. Thus, in phase two of the analysis we apportion the results of the phase one analysis to the underlying NO_X, SO_3, and PM emission reductions and scale the apportioned benefits to reflect differences in emissions reductions between the modeled preliminary control option and the proposed standards. The sum of the scaled benefits for the PM, SO_3, and NO_X emission reductions provide us with the total benefits of the rule.

The benefit estimates derived from the modeled preliminary control option in phase one of our analysis uses an analytical structure and sequence similar to that used in the benefits analyses for the Heavy Duty Engine/Diesel Fuel final rule and in the ''section 812 studies'' to estimate the total benefits and costs of the full Clean Air Act.[292] We used many of the same models and assumptions used in the Heavy Duty Engine/Diesel Fuel analysis as well as other Regulatory Impact Analyses (RIAs) prepared by the Office of Air and Radiation. By adopting the major design elements, models, and assumptions developed for the section 812 studies and other RIAs, we have largely relied on methods which have already received extensive review by the independent Science Advisory Board (SAB), by the public, and by other federal agencies. In addition, we will be working through the next section 812 study process to enhance our methods.[293] Interested parties will therefore be able to obtain further information from the section 812 study on the kinds of methods we are likely to use for estimating benefits and costs in the final nonroad diesel rule.

The benefits transfer method used in phase two of the analysis is similar to that used to estimate benefits in the recent analysis of the Nonroad Large Spark-Ignition Engines and Recreational Engines standards (67 FR 68241, November 8, 2002). A similar method has also been used in recent benefits analyses for the proposed Industrial Boilers and Process Heaters NESHAP and the Reciprocating Internal Combustion Engines NESHAP.

On September 26, 2002, the National Academy of Sciences (NAS) released a report on its review of the Agency's methodology for analyzing the health benefits of measures taken to reduce air pollution. The report focused on EPA's approach for estimating the health benefits of regulations designed to reduce concentrations of airborne particulate matter (PM).

In its report, the NAS said that EPA has generally used a reasonable framework for analyzing the health benefits of PM-control measures. It recommended, however, that the Agency take a number of steps to improve its benefits analysis. In particular, the NAS stated that the Agency should:

- Include benefits estimates for a range of regulatory options;
- Estimate benefits for intervals, such as every five years, rather than a single year;
- Clearly state the projected baseline statistics used in estimating health benefits, including those for air emissions, air quality, and health outcomes;
- Examine whether implementation of proposed regulations might cause unintended impacts on human health or the environment;
- When appropriate, use data from non-U.S. studies to broaden age ranges to which current estimates apply and to include more types of relevant health outcomes;
- Begin to move the assessment of uncertainties from its ancillary analyses into its Base analyses by conducting probabilistic, multiple-source uncertainty analyses. This assessment should be based on available data and expert judgment.

Although the NAS made a number of recommendations for improvement in EPA's approach, it found that the studies selected by EPA for use in its benefits analysis were generally reasonable choices. In particular, the NAS agreed with EPA's decision to use cohort studies to derive benefits estimates. It also concluded that the Agency's selection of the American Cancer Society (ACS) study for the evaluation of PM-related premature mortality was reasonable, although it noted the publication of new cohort studies that should be evaluated by the Agency.

EPA has addressed many of the NAS comments in our analysis of the proposed rule. We provide benefits estimates for each year over the rule implementation period for a wide range of regulatory alternatives, in addition to our proposed emission control program. We use the estimated time path of benefits and costs to calculate the net present value of benefits of the rule. In the RIA, we provide baseline statistics for air emissions, air quality, population, and health outcomes. We have examined how our benefits estimates might be impacted by expanding the age ranges to which epidemiological studies are applied, and we have added several new health endpoints, including non-fatal heart attacks, which are supported by both U.S. studies and studies conducted in Europe. We have also improved the documentation of our methods and provided additional details about model assumptions.

Several of the NAS recommendations addressed the issue of uncertainty and how the Agency can better analyze and communicate the uncertainties associated with its benefits assessments. In particular, the Committee expressed concern about the Agency's reliance on a single value from its analysis and suggested that EPA develop a probabilistic approach for analyzing the health benefits of proposed regulatory actions. The Agency agrees with this suggestion and is working to develop such an approach for use in future rulemakings. EPA plans to hold a meeting of its Science Advisory Board (SAB) in early Summer 2003 to review its plans for addressing uncertainty in its analyses. Our likely approach will incorporate short-term elements intended to provide interim methods in time for the final Nonroad rule to address uncertainty in important analytical parameters such as the concentration-response relationship for PM-related premature mortality. Our approach will also include longer-term elements intended to provide scientifically sound, peer-reviewed characterizations of the uncertainty surrounding a broader set of analytical parameters and assumptions, including but not limited to emissions and air quality modeling, demographic projections, population health status, concentration-response functions, and valuation estimates.

3. What Are the Significant Limitations of the Benefit-Cost Analysis?

Every benefit-cost analysis examining the potential effects of a change in

[292] The section 812 studies include: (1) US EPA, Report to Congress: The Benefits and Costs of the Clean Air Act, 1970 to 1990, October 1997 (also known as the ''Section 812 Retrospective Report''); and (2) the first in the ongoing series of prospective studies estimating the total costs and benefits of the Clean Air Act (*see* EPA report number: EPA–410–R–99–001, November 1999). *See* Docket A–99–06, Document II–A–21.

[293] We anticipate a public SAB meeting June 11–13, 2003, in Washington, DC, regarding components of our analytical blueprint. Interested parties may want to consult the Web page: *http://www.epa.gov/science1.*

environmental protection requirements is limited to some extent by data gaps, limitations in model capabilities (such as geographic coverage), and uncertainties in the underlying scientific and economic studies used to configure the benefit and cost models. Deficiencies in the scientific literature often result in the inability to estimate quantitative changes in health and environmental effects, such as potential increases in premature mortality associated with increased exposure to carbon monoxide. Deficiencies in the economics literature often result in the inability to assign economic values even to those health and environmental outcomes which can be quantified. While these general uncertainties in the underlying scientific and economics literatures, which can cause the valuations to be higher or lower, are discussed in detail in the Regulatory Support Document and its supporting documents and references, the key uncertainties which have a bearing on the results of the benefit-cost analysis of this final rule include the following:

- The exclusion of potentially significant benefit categories (such as health and ecological benefits of reduction in CO, VOCs, air toxics, and ozone);
- Errors in measurement and projection for variables such as population growth;
- Uncertainties in the estimation of future year emissions inventories and air quality;
- Uncertainties associated with the scaling of the results of the modeled benefits analysis to the proposed standards, especially regarding the assumption of similarity in geographic distribution between emissions and human populations and years of analysis;
- Variability in the estimated relationships of health and welfare effects to changes in pollutant concentrations;
- Uncertainties in exposure estimation;
- Uncertainties associated with the effect of potential future actions to limit emissions.

Despite these uncertainties, we believe the benefit-cost analysis provides a reasonable indication of the expected economic benefits of the proposed rulemaking in future years under a set of assumptions.

One significant limitation to the benefit transfer method applied in this analysis is the inability to scale ozone-related benefits. Because ozone is a homogeneous gaseous pollutant, it is not possible to apportion ozone benefits to the precursor emissions of NO_X and VOC. Coupled with the potential for NO_X reductions to either increase or decrease ambient ozone levels, this prevents us from scaling the benefits associated with a particular combination of VOC and NO_X emissions reductions to another. Because of our inability to scale ozone benefits, we do not include ozone benefits as part of the monetized benefits of the proposed standards. For the most part, ozone benefits contribute substantially less to the monetized benefits than do benefits from PM, thus their omission will not materially affect the conclusions of the benefits analysis. Although we expect economic benefits to exist, we were unable to quantify or to value specific changes in ozone, CO or air toxics because we did not perform additional air quality modeling.

There are also a number of health and environmental effects which we were unable to quantify or monetize. A full appreciation of the overall economic consequences of the proposed rule requires consideration of all benefits and costs expected to result from the new standards, not just those benefits and costs which could be expressed here in dollar terms. A complete listing of the benefit categories that could not be quantified or monetized in our estimate are provided in Table V.E–5. These effects are denoted by ''B'' in Table V.E–3 above, and are additive to the estimates of benefits.

TABLE V.E–5.—ADDITIONAL, NON-MONETIZED BENEFITS OF THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS

Pollutant	Unquantified effects
Ozone Health	Premature mortality.[a]
	Increased airway responsiveness to stimuli.
	Inflammation in the lung.
	Chronic respiratory damage.
	Premature aging of the lungs.
	Acute inflammation and respiratory cell damage.
	Increased susceptibility to respiratory infection.
	Non-asthma respiratory emergency room visits.
	Increased school absence rates.
Ozone Welfare	Decreased yields for commercial forests (for example, Western US).
	Decreased yields for fruits and vegetables.
	Decreased yields for non-commercial crops.
	Damage to urban ornamental plants.
	Impacts on recreational demand from damaged forest aesthetics.
	Damage to ecosystem functions.
PM Health	Infant mortality.
	Low birth weight.
	Changes in pulmonary function.
	Chronic respiratory diseases other than chronic bronchitis.
	Morphological changes.
	Altered host defense mechanisms.
	Cancer.
	Non-asthma respiratory emergency room visits.
PM Welfare	Visibility in many Class I areas.
	Residential and recreational visibility in non-Class I areas.
	Soiling and materials damage.
	Damage to ecosystem functions.

TABLE V.E–5.—ADDITIONAL, NON-MONETIZED BENEFITS OF THE PROPOSED NONROAD DIESEL ENGINE AND FUEL STANDARDS—Continued

Pollutant	Unquantified effects
Nitrogen and Sulfate Deposition Welfare.	Impacts of acidic sulfate and nitrate deposition on commercial forests. Impacts of acidic deposition to commercial freshwater fishing. Impacts of acidic deposition to recreation in terrestrial ecosystems. Reduced existence values for currently healthy ecosystems. Impacts of nitrogen deposition on commercial fishing, agriculture, and forests. Impacts of nitrogen deposition on recreation in estuarine ecosystems. Damage to ecosystem functions.
CO Health	Premature mortality.[a] Behavioral effects.
HC Health[b]	Cancer (benzene, 1,3-butadiene, formaldehyde, acetaldehyde).
HC Welfare	Direct toxic effects to animals. Bioaccumulation in the food chain. Damage to ecosystem function. Odor.

Notes:

[a] Premature mortality associated with ozone and carbon monoxide is not separately included in this analysis. In this analysis, we assume that the ACS/Krewski, *et al.* C–R function for premature mortality captures both PM mortality benefits and any mortality benefits associated with other air pollutants. A copy of Krewski, *et al.,* can be found in Docket A–99–06, Document No. IV–G–75.

[b] Many of the key hydrocarbons related to this rule are also hazardous air pollutants listed in the Clean Air Act.

F. Economic Impact Analysis

An Economic Impact Analysis (EIA) was prepared to estimate the economic impacts of this proposal on producers and consumers of nonroad engines and equipment and related industries. The Nonroad Diesel Economic Impact Model (NDEIM), developed for this analysis, was used to estimate market-level changes in price and outputs for affected engine, equipment, fuel, and application markets as well as the social costs and their distribution across economic sectors affected by the program. This section presents the results of the economic impact analysis. A detailed description of the NDEIM, the model inputs, and several sensitivity analyses can be found in chapter 10 of the Draft Regulatory Impact Analysis prepared for this proposal.

1. What Is an Economic Impact Analysis?

Regulatory agencies conduct economic impact analyses of potential regulatory actions to inform decision makers about the effects of a proposed regulation on society's current and future well-being. In addition to informing decision makers within the Agency, economic impact analyses are conducted to meet the statutory and administrative requirements imposed by Congress and the Executive office. The Clean Air Act requires an economic impact analysis under section 317, while Executive Order 12866—Regulatory Planning and Review requires Executive Branch agencies to perform benefit-costs analyses of all rules it deems to be ''significant'' (typically over $100 million annual social costs) and submit these analyses to the Office of Management and Budget (OMB) for review. This economic impact analysis estimates the potential market impacts of the proposed rule's compliance costs and provides the associated social costs and their distribution across stakeholders for comparison with social benefits (as presented in Section V.E).

2. What Is EPA's Economic Analysis Approach for This Proposal?

The underlying objective of an EIA is to evaluate the effect of a proposed regulation on the welfare of affected stakeholders and society in general. Using information on the expected compliance costs of the proposed program as presented in the preceding discussion, this EIA explores how the companies that produce nonroad diesel engines, equipment, or fuel may change their production behavior in response to the costs of complying with the standards. It also explores how the consumers who use the affected products may change their purchasing decisions. For example, the construction industry may reduce purchases if the prices of nonroad diesel equipment increase, thereby reducing the volume of equipment sold (or market demand) for such equipment. Alternatively, the construction industry may pass along these additional costs to the consumers of their final goods and services by increasing prices, which would mitigate the potential impacts on the purchases of nonroad diesel equipment.

The conceptual approach of the NDEIM is to link significantly affected markets to mimic how compliance costs will potentially ripple through the economy. The compliance costs will be directly borne by engine manufacturers, equipment manufacturers, and petroleum refineries. Depending on market characteristics, some or all of these compliance costs will be passed on through the supply chain in the form of higher prices extending to producers and consumers in the application markets (*i.e.*, construction, agriculture, and manufacturing). The NDEIM explicitly models these linkages and estimates behavioral responses that lead to new equilibrium prices and output for all related markets and the resulting distribution of costs across stakeholders.

The NDEIM uses a multi-market partial equilibrium approach to track changes in price and quantity for 60 integrated product markets, as follows:

- 7 diesel engine markets (less than 25 hp, 26 to 50 hp, 51 to 75 hp, 76 to 100 hp, 101 to 175 hp, 176 to 600 hp, and greater than 600 hp; the EIA includes more horsepower categories than the standards, allowing more efficient use of the engine compliance cost estimates developed for this proposal).
- 42 diesel equipment markets (7 horsepower categories within 7 application categories: agricultural, construction, general industrial, pumps and compressors, generator and welder sets, refrigeration and air conditioning, and lawn and garden; there are 7 horsepower/application categories that did not have sales in 2000 and are not included in the model, so the total number of diesel equipment markets is 42 rather than 49).
- 3 application markets (agricultural, construction, and manufacturing).
- 8 nonroad diesel fuel markets (2 sulfur content levels of 15 ppm and 500 ppm for each of 4 PADDs; PADDs 1 and

3 are combined for the purpose of this analysis). It should be noted that PADD 5 includes Alaska and Hawaii. Because those two states are geographically separate from the rest of PADD 5, we seek comment on whether they should be considered as separate fuel markets.

The NDEIM uses an intermediate run time frame and assumes perfect competition in the market sectors. It is a computer model comprised of a series of spreadsheet modules that define the baseline characteristics of the supply and demand for the relevant markets and the relationships between them. A detailed description of the model methodology, inputs, and parameters is provided in chapter 10 of the draft RIA prepared for this proposal. The model methodology is firmly rooted in applied microeconomic theory and was developed following the OAQPS Economic Analysis Resource Document.[294] Based on the specified market linkages, the model is shocked by applying the engineering compliance cost estimates to the appropriate market suppliers and then numerically solved using an iterative auctioneer approach by ''calling out'' new prices until a new equilibrium is reached in all markets simultaneously.

The actual economic impacts of the proposed rule will be determined by the ways in which producers and consumers of the engines, equipment, and fuels affected by the proposal change their behavior in response to the costs incurred in complying with the standards. In the NDEIM, these behaviors are modeled by the demand and supply elasticities. The supply elasticities for the engine and equipment markets and the demand elasticities for the application markets were estimated using econometric methods. The procedures and results are reported in Appendix 10.1 of the draft RIA. Literature-based estimates were used for the supply elasticities in the application and fuel markets.

There are two ways to handle the demand elasticities for the engine, equipment, and fuel markets. In the approach used in NDEIM, these demand elasticities are internally derived based on the specified market linkages, *i.e.*, the demand for engines, equipment, and fuel are modeled as directly related to the supply and demand of goods and services supplied by the final application markets. In other words, the supply of those goods and services determines the demand for equipment and fuel, and the supply of equipment determines the demand for engines. Using this approach, the NDEIM predicts that engine and equipment production will decrease by only a small amount: 0.013% and 0.014% respectively (see Table V.F–1). Also, please see draft RIA Appendices 10A and 10B for more detailed estimates on the price increase estimates. Because the application markets are modeled with inelastic or unit elastic demand and supply elasticities (quantity supplied/demanded is expected to be fairly insensitive to price changes or they will vary directly with price changes), the model predicts that engine and equipment manufacturers will pass along virtually all of their costs to end users.

An alternative approach could be used in which the demand elasticities for the equipment, engine, and fuel markets are not derived as part of the model. They could be estimated separately or a sensitivity analysis could be conducted that assumes more elastic values than those generated by the NDEIM. We are continuing to investigate this matter and will be placing additional information about elasticities in the docket during the comment period for this rule. We request comment on that information as well as on the methodology and other aspects of this EIA.

The estimated engine and equipment market impacts are based solely on the expected increase in variable costs associated with the proposed standards. Fixed costs associated with the engine emission standards are not included in the market analysis reported in Table IV–F–1. This is because in an analysis of competitive markets the industry supply curve is based on its marginal cost curve, and fixed costs are not reflected in changes in the marginal cost curve. In addition, fixed costs are primarily R&D costs associated with design and engineering changes, and firms in the affected industries currently allocate funds for these costs. Therefore, fixed costs are not likely to affect the prices of engines or equipment. This assumption is described in greater detail in section 10.2 of the draft RIA. R&D costs are a long-run concern and decisions to invest or not invest in R&D are made in the long run. If funds have to be diverted from some other activity into R&D needed to meet the environmental regulations, then these costs represent a component of the social costs of the rule. Therefore, fixed costs are included in the welfare impact estimates reported in Table V.F–2 as additional costs on producers. We also performed a sensitivity analysis, included in chapter 10 of the draft RIA for this proposal, that includes fixed costs as part of the model. This results in a transfer of welfare losses from engine and equipment markets to the application markets, but does not change the overall welfare losses associated with the proposal.

Economic theory indicates that, in the long run, prices are expected to reflect the average total costs of the marginal producer in a market and not just variable costs. This suggests that it may be necessary to treat fixed costs differently for a long-run analysis. We will continue to investigate this effect and intend to place additional information in the docket during the comment period for this rule. We request comment on that information as well as on how fixed costs and R&D expenditures are handled in the NDEIM.

In addition to the variable and fixed costs described above, there are three additional costs components that are included in the total social cost estimates of the proposed regulation but that are not explicitly included in the NDEIM. These are operating savings (costs), fuel marker costs, and spillover from 15 ppm fuel to higher sulfur fuel. We request comment on how best to incorporate each of these costs in the analysis.

Operating savings (costs) refers to changes in operating costs that are expected to be realized by users of both existing and new nonroad diesel equipment as a result of the reduced sulfur content of nonroad diesel fuel. These include operating savings (cost reductions) due to fewer oil changes, which accrue to nonroad engines, and marine and locomotive engines, that are already in use as well as new nonroad engines that will comply with the proposed standards (*see* section V.B.). These savings (costs) also include any extra operating costs associated with the new PM emission control technology which may accrue to new engines that use this new technology. These savings (costs) are not included directly in the model because some of the savings accrue to existing engines and because these savings (costs) are not expected to affect consumer decisions with respect to new engines. Instead, they are added into the estimated welfare impacts as additional costs to the application markets, since it is the users of these engines that will see these savings (costs). Nevertheless, a sensitivity analysis was also performed in which these savings (costs) are included as inputs to the NDEIM, where they are modeled as benefits accruing to the application producers. The results of

[294] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Innovative Strategies and Economics Group, OAQPS Economic Analysis Resource Document, April 1999. A copy of this document can be found in Docket A–2001–28, Document No. II–A–14.

this analysis are presented in Chapter 10 of the draft RIA.

Fuel marker costs refers to costs associated with marking high sulfur diesel fuel in the locomotive, marine, and heating oil markets between 2007 and 2014. Marker costs are not included in the market analysis because locomotive, marine, and heating oil markets are not explicitly modeled in the NDEIM. Similar to the operating savings (costs), marker costs are added into the estimated welfare impacts separately.

The costs of fuel that spills over from the 15 ppm market to higher grade sulfur fuel are also not included in the NDEIM but, instead, are added into the estimated welfare impacts separately. As described in section IV above, refiners are expected to produce more 15 ppm fuel than is required for the nonroad diesel fuel market. This excess 15 ppm fuel will be sold into markets that allow fuel with a higher sulfur level (*e.g.*, locomotive, marine diesel, or home heating fuel). Because this spillover fuel will meet the 15 ppm limit, it is necessary to count the costs of sulfur reduction processes against those fuels.

Consistent with the engine and equipment cost discussion in section V.C. of this preamble, the EIA does not include any cost savings associated with the proposed equipment transition flexibility program or the proposed nonroad engine ABT program. As a result, the results of this EIA can be viewed as somewhat conservative, in this respect.

3. What Are the Results of this Analysis?

The economic analysis consists of two parts: a market analysis and welfare analysis. The market analysis looks at expected changes in prices and quantities for directly and indirectly affected market commodities. The welfare analysis looks at economic impacts in terms of annual and present value changes in social costs. For this proposed rule, the social costs are computed as the sum of market surplus offset by operating cost savings. Market surplus is equal to the aggregate change in consumer and producer surplus based on the estimated market impacts associated with the proposed rule. Operating cost savings are associated with the decreased sulfur content of diesel fuel. These include maintenance savings (cost reductions) and changes in fuel efficiency. Increased maintenance costs may also be incurred for some technologies. Operating costs are not included in the market analysis but are instead listed as a separate category in the social cost results tables.

Economic impact results for 2013, 2020, and 2030 are presented in this section. The first of these years, 2013, corresponds to the first year in which the standards affect all engines, equipment, and fuels. It should be noted that, as illustrated in Table V.D–2, above, aggregate program costs peak in 2014; increases in costs after that year are due to increases in the population of engines over time. The other years, 2020 and 2030, correspond to years analyzed in our benefits analysis. Detailed results for all years are included in Appendix 10.E. for this chapter.

a. Expected Market Impacts

The market impacts of this rule suggest that the overall economic impact of the proposed emission control program on society is expected to be small, on average. According to this analysis, the average prices of goods and services produced using equipment and fuel affected by the proposal are expected to increase by about 0.02 percent. The estimated price increases and quantity reductions for engines and equipment vary depending on compliance costs. In general, we would expect for price increases to be higher (lower) as a result of a high (low) relative level of compliance costs to market price. We would also expect the change in price to be highest when compliance costs are highest.

The estimated market impacts for 2013, 2020, and 2030 are presented in Table V.F–1. The market-level impacts presented in this table represent production-weighted averages of the individual market-level impact estimates generated by the model: the average expected price increase and quantity decrease across all of the units in each of the engine, equipment, fuel, and final application markets. For example, the model includes seven individual engine markets that reflect the different horsepower size categories. The 23 percent price change for engines shown in Table V.F–1 for 2013 is an average price change across all engine markets weighted by the number of production units. Similarly, equipment impacts presented in Table V.F–1 are weighted averages of 42 equipment-application markets, such as small (< 25hp) agricultural equipment and large (>600hp) industrial equipment. It should be noted that price increases and quantity decreases for specific types of engines, equipment, application sectors, or diesel fuel markets are likely to be different. But the data in this table provide a broad overview of the expected market impacts that is useful when considering the impacts of the proposal on the economy as a whole.

The individual market-level impacts are presented in Chapter 10 of the draft RIA for this proposal.

Engine Market Results: Most of the variable costs associated with the proposed rule are passed along in the form of higher prices. The average price increase in 2013 for engines is estimated to be about 23 percent. This percentage is expected to decrease to about 19.5 percent for 2020 and later. This expected price increase varies by engine size because compliance costs are a larger share of total production costs for smaller engines. In 2013, the year of greatest compliance costs overall, the largest expected percent price increase is for engines between 25 and 50 hp: 34 percent or $852; the average price for an engine in this category is about $2,500. However, this price increase is expected to drop to 26 percent, or about $647, for 2016 and later. The smallest expected percent price increase in 2013 is for engines in the greater than 600 hp category. These engines are expected to see price increases of about 3 percent increase in 2013, increasing to about 5.6 percent in 2014 and beyond. The expected price increase for these engines is about $4,211 in 2013, increasing to about $6,950 in 2014 and later, for engines that cost on average about $125,000.

The market impact model predicts that even with these increases in engine prices, total demand is not expected to change very much. The expected average change in quantity is only about 69 engines per year in 2013, out of total sales of more than 500,000 engines. The estimated change in market quantity is small because as compliance costs are passed along the supply chain they become a smaller share of total production costs. In other words, firms that use these engines and equipment will continue to purchase them even at the higher cost because the increase in costs will not have a large impact on their total production costs. Diesel equipment is only one factor of production for their output of construction, agricultural, or manufactured goods. The average decrease in the quantity of all engines produced as a result of the regulation is estimated to be about 0.013 percent. This decrease ranges from 0.010 percent for engines less than 25 hp to 0.016 percent for engines 175 to 600 hp.

Equipment Market Results: Estimated price changes for the equipment markets reflect both the direct costs of the proposed standards on equipment production and the indirect cost through increased engine prices. In 2013, the average price increase for nonroad diesel equipment is estimated to be about 5.2 percent. This percentage is expected to decrease to about 4.5 percent for 2020 and beyond. The range of estimated price increases across equipment types parallels the share of engine costs relative to total equipment price, so the estimated percentage price increase among equipment types also varies. The market price in 2013 for agricultural equipment between 175 and 600 hp is estimated to increase about 1.4 percent, or $1,835 for equipment with an average cost of $130,000. This compares with an estimated engine price increase of about $1,754 for engines of that size. The largest expected price increase in 2013 for equipment is $4,335, or 4.9 percent, for pumps and compressors over 600 hp. This compares with an estimated engine price increase of about $4,211 for engines of that size. The smallest expected price increase in 2013 for equipment is $125, or 3.6 percent, for construction equipment less than 25 hp. This compares with an estimated engine price increase of about $124 for engines of that size. The price changes for the equipment are less than that for engines because the engine is only one input in the production of equipment.

The output reduction for nonroad diesel equipment is estimated to be very small and to average about 0.014 percent for all years. This decrease ranges from 0.005 percent for general manufacturing equipment to 0.019 percent for construction equipment. The largest expected decrease in quantity in 2013 is 13 units of construction equipment per year for construction equipment between 100 and 175 hp, out of about 62,800 units. The smallest expected decrease in quantity in 2013 is less than one unit per year in all hp categories of pumps and compressors.

TABLE V.F–1.—SUMMARY OF MARKET IMPACTS ($2001)

Market	Engineering cost	Change in price		Change in quantity	
	Per unit	Absolute ($million)	Percent	Absolute	Percent
2013					
Engines	$1,087	$840	22.9	−69 [a]	−0.013
Equipment	1,021	1,017	5.2	−118	−0.014
Application Markets [b]			0.02		−0.010
No. 2 Distillate Nonroad	0.039	0.038	4.1	−1.38 [c]	−0.013
2020					
Engines	$1,028	$779	19.5	−79 [a]	−0.013
Equipment	1,018	1,013	4.4	−135	−0.014
Application Markets [b]			0.02		−0.010
No. 2 Distillate Nonroad	0.039	0.039	4.1	−1.58 [c]	−0.014
2030					
Engines	$1,027	$768	19.4	−92 [a]	−0.013
Equipment	1,004	999	4.5	−156	−0.014
Application Markets [b]			0.02		−0.010
No. 2 Distillate Nonroad	0.039	0.039	4.1	−1.84 [c]	−0.014

Notes:

[a] The absolute change in the quantity of engines represents only engines sold on the market. Reductions in engines consumed internally by integrated engine/equipment manufacturers are not reflected in this number but are captured in the cost analysis. For this reason, the absolute change in the number of engines and equipment does not match.

[b] The model uses normalized commodities in the application markets because of the great heterogeneity of products. Thus, only percentage changes are presented.

[c] Units are in million of gallons.

Application Market Results: The estimated price increase associated with the proposed standards in all three of the application markets is very small and averages about 0.02 percent for all years. In other words, on average, the prices of goods and services produced using the engines, equipment, and fuel affected by this proposal are expected to increase only negligibly. This is because in all of the application markets the compliance costs passed on through price increases represent a very small share of total production costs. For example, the construction industry realizes an increase in production costs of approximately $468 million in 2013 because of the price increases for diesel equipment and fuel. However, this represents only 0.03 percent of the $1,392 billion value of shipments in the construction industry in 2001. The estimated average commodity price increase in 2013 ranges from 0.06 percent in the agricultural application market to about 0.01 percent in the manufacturing application market. The percentage change in output is also estimated to be very small and averages about 0.01 percent. This reduction ranges from less than a 0.01 percent decrease in manufacturing to about a 0.02 percent decrease in construction. Note that these estimated price increases and quantity decreases are average for these sectors and may vary for specific subsectors. Also, note that absolute changes in price and quantity are not provided for the application markets in Table V.F–1 because normalized commodity values are used in the market model. Because of the great heterogeneity of manufactured or agriculture products, a normalized commodity ($1 unit) is used in the application markets. This has no impact on the estimated percentage change impacts but makes interpretation of the absolute changes less informative.

Fuel Markets Results: The estimated average price increase across all nonroad diesel fuel is about 4 percent for all years. For 15 ppm fuel, the estimated price increase for 2013 ranges from 3.2 percent in the East Coast region (PADD 1&3) to 9.3 percent in the mountain region (PADD 4). The average national output decrease for all fuel is estimated to be about 0.01 percent for all years, and is relatively constant across all four regional fuel markets.

b. Expected Welfare Impacts

Social cost impact estimates are presented in Table V.F–2. A time series of social costs from 2007 through 2030 is presented in Table IV.F–3. As described above, the total social cost of the regulation is the sum of the changes in producer and consumer surplus estimated by the model plus engine maintenance savings (negative costs) resulting from using fuel with a lower sulfur content. Total social costs in 2013 are projected to be 1,202.4 million ($2001). About 82 percent of the total social costs is expected to be borne by producers and consumers in the application markets, indicating that the majority of the costs are expected to be passed on in the form of higher prices. When these estimated impacts are broken down, 58 percent are expected to be borne by consumers in the application markets and 42 percent are expected to be borne by producers in the application markets. Equipment manufacturers are expected to bear about 10 percent of the total social costs. Engine manufacturers and diesel fuel refineries are expected to bear 2.5 percent and 0.5 percent, respectively. The remaining 5.0 percent is accounted for by fuel marker costs and the additional costs of 15 ppm fuel being sold in to markets such as marine diesel, locomotive, and home heating fuel that do not require it.

In 2030, the total social costs are projected to be about $1,509.6 million ($2001). The increase is due to the projected annual growth in the engine and equipment populations. As in earlier years, producers and consumers in the application markets are expected to bear the large majority of the costs, approximately 94 percent. This is consistent with economic theory, which states that, in the long run, all costs are passed on to the consumers of goods and services.

The present value of total social costs through 2030 is estimated to be $16.5 billion ($2001). This present value is calculated using a social discount rate of 3 percent from 2004 through 2030. We also performed an analysis using an alternative 7 percent social discount rate. Using that discount rate, the present value of the social costs through 2030 is estimated to be $9.9 billion ($2001).

TABLE V.F–2.—SUMMARY OF SOCIAL COSTS ESTIMATES ASSOCIATED WITH PRIMARY PROGRAM: 2013, 2020, AND 2030

[$million][a,b]

	Maximum cost year (2013)			Year 2020			Final year (2030)		
	Market surplus ($\$10^6$)	Operating savings ($\$10^6$)	Total	Market surplus ($\$10^6$)	Operating savings ($\$10^6$)	Total	Market surplus ($\$10^6$)	Operating savings ($\$10^6$)	Total
Engine Producers									
Total	30.2	....	30.2	0.1	....	0.1	0.1	....	0.1
Equipment Producers									
Total	116.1	....	116.1	102.6	....	102.6	5.3	....	5.3
Agricultural Equipment	39.9	....	39.9	33.2	....	33.2	1.3	....	1.3
Construction Equipment	53.0	....	53.0	48.2	....	48.2	3.8	....	3.8
Industrial Equipment	23.2	....	23.2	21.2	....	21.2	0.2	....	0.2
Application Producers and Consumers									
Total	1,231.8	(241.9)	989.8	1,386.5	(190.1)	1,196.3	1,598.9	(174.5)	1,424.5
Total Producer	515.7	....	....	583.4	....	....	672.9	....	....
Total Consumer	716.1	....	....	803.1	....	....	926.0	....	....
Agriculture	348.7	(44.7)	304.0	339.2	(35.2)	364.0	416.5	(32.3)	429.2
Construction	468.3	(77.9)	390.4	550.4	(61.2)	489.3	635.7	(56.1)	579.5
Manufacturing	414.8	(119.3)	295.5	436.8	(93.8)	343.0	501.8	(86.0)	415.7
Fuel Producers Total	7.8	....	7.8	9.0	....	9.0	10.5	....	10.5
PADD I&III	3.6	....	3.6	4.1	....	4.1	4.8	....	4.8
PADD II	2.9	....	2.9	3.3	....	3.3	3.9	....	3.9
PADD IV	0.8	....	0.8	0.9	....	0.9	1.0	....	1.0
PADD V	0.5	....	0.5	0.6	....	0.6	0.8	....	0.8
Nonroad Spillover	....	51.2	....	....	58.6	....	....	69.2	
Marker Costs	....	7.3	....	....	....	....	....	....	....
Total	1,385.8	(183.4)	1,202.4	1,498.2	(131.5)	1,366.7	1,614.9	(105.3)	1,509.6

Notes:
[a] Figures are in 2001 dollars.
[b] Operating savings are shown as negative costs.

TABLE IV.F–3—NATIONAL ENGINEERING COMPLIANCE COSTS AND SOCIAL COSTS ESTIMATES FOR THE PROPOSED RULE: 2004–2030

[$10 6] [a]

Year	Engineering compliance costs	Total social costs[b]
2004	0.00	0.00
2005	0.00	0.00
2006	0.00	0.00
2007	39.61	39.61
2008	130.41	130.40
2009	132.25	132.25
2010	262.02	262.01
2011	641.12	641.07
2012	1,010.37	1,010.27
2013	1,202.52	1,202.40
2014	1,329.14	1,329.01
2015	1,260.74	1,260.62
2016	1,298.40	1,298.27
2017	1,318.75	1,318.62
2018	1,325.02	1,324.89
2019	1,339.30	1,339.16
2020	1,366.79	1,366.66
2021	1,351.08	1,350.94
2022	1,349.58	1,349.44
2023	1,365.53	1,365.38
2024	1,371.60	1,371.45
2025	1,395.98	1,395.83
2026	1,419.79	1,419.64
2027	1,442.91	1,442.76
2028	1,465.41	1,465.26
2029	1,487.68	1,487.53
2030	1,509.77	1,509.61
NPV at 3%	16,524.29	16,522.66
NPV at 7%	9,894.02	9,893.06

Notes:

[a] Figures are in 2001 dollars.

[b] Figures in this column do not include the human health and environmental benefits of the proposal.

VI. Alternative Program Options

Our proposed emission control program consists of a two-step program to reduce the sulfur content of nonroad diesel fuel in conjunction with the proposed Tier 4 engine standards. As we developed this proposal, we evaluated a number of alternative options with regard to the scope, level, and timing of the standards. This section presents a summary of our analysis of several alternative control scenarios. A complete discussion of all the alternatives, their feasibility, and their inventory, benefits, and cost impacts can be found in Chapter 12 of the draft Regulatory Impact Analysis for this proposal.

While we are interested in comments on all of the alternatives presented, we are especially interested in comments on two alternative scenarios which EPA believes merit further consideration in developing the final rule: a program in which sulfur levels are required to be reduced to 15 ppm in essentially a single step, and a variation on the proposed two-step fuel control program, in which the second step of sulfur control to 15 ppm in 2010 would apply to locomotive and marine diesel fuel in addition to nonroad diesel fuel. This section describes these two options in greater detail; additional information can be found in Chapter 12 of the draft Regulatory Impact Analysis for this proposal.

A. Summary of Alternatives

We developed emissions, benefits, and cost analyses for a number of alternatives. The alternatives we considered can be categorized according to the structure of their fuel requirements: whether the 15 ppm fuel sulfur limit is reached in two-steps, like the proposed program, or one-step.

One-step alternatives are those in which the fuel sulfur standard is applied in a single step: there are no fuel-based phase-ins. We evaluated three one-step alternatives. Option 1 is described in detail in Section VI.B, below. We considered two other one-step alternatives which differ from Option 1 in the timing of the fuel option (2006 or 2008) and the engines standards (level of the standards and when they are introduced). As described in Table IV–1, Option 1b differs from Option 1 regarding the timing of the fuel standards, while Option 1a differs from Option 1 in terms of the engine standards. Both Option 1a and 1b would also extend the 15 ppm fuel sulfur limit to locomotive and marine diesel fuel as well.

Two-step alternatives are those in which the fuel sulfur standard is set first at 500 ppm and then is reduced to 15 ppm. The two-step alternatives vary from the proposal in terms of both the timing and levels of the engine standards and the timing of the fuel standards. Option 2a is the same as the proposed program except the 500 ppm fuel standard is introduced a year earlier, in 2006. Option 2b is the same as the proposed program except the 15 ppm fuel standard is introduced a year earlier in 2009 and the trap-based PM standards begin earlier for all engines. Option 2c is the same as the proposed program except the 15 ppm fuel standard is introduced a year earlier in 2009 and the trap-based PM standards begin earlier for engines 175–750 hp. Option 2d is the same as the proposed program except the NO_X standard is reduced to 0.30 g/bhp-hr for engines 25–75 hp, and this standard is phased in. Finally, Option 2e is the same as the proposed program except there are no new Tier 4 NO_X limits.

Options 3 and 4 are identical to the proposed program, except Option 3 would exempt mining equipment over 750 hp from the Tier 4 standards, and Option 4 would include applying the 15 ppm sulfur limit to both locomotive and marine diesel fuel. Option 4 is discussed in detail in Section IV.C, below.

Option 5a and 5b are identical to the proposal except for the treatment of engines less than 75 hp. Option 5a is identical to the proposal except that no new program requirements would be set in Tier 4 for engines under 75 hp. Instead Tier 2 standards and testing requirements for engines under 50 hp, and Tier 3 standards and testing requirements for 50–75 hp engines, would continue indefinitely. The Option 5b program is identical to the proposal except that for engines under 75 hp only the 2008 engine standards would be set. There would be no additional PM filter-based standard in 2013 for 25–75 hp engines, and no additional NO_X+NMHC standard in 2013 for 25–50 hp engines.

Table VI–1 contains a summary of a number of these alternatives and the expected emission reductions, costs, and monetized benefits associated with them in comparison to the proposal. These alternatives cover a broad range of possible approaches and serve to provide insight into the many other program design alternatives not expressly evaluated further. The analysis was done using a 3% discount rate. If we were to use another rate, the values would change but not to such a degree as to change our conclusions regarding the various options. A complete discussion of all the alternatives, their feasibility, and their inventory, benefits, and cost impacts can be found in Chapter 12 of the draft Regulatory Impact Analysis for this proposal.

TABLE VI-1 – SUMMARY OF ALTERNATIVE PROGRAM OPTIONS (INCREMENTAL TO THE PROPOSAL)

Option	Fuel Standards	Engine Standards	Estimated Relative Inventory Impacts[c] (NPV tons thru 2030; 3% discount)	Estimated Cost Impacts - $Billion (NPV thru 2030; 3%)	Estimated Benefits Stream - $Billion[e] (NPV thru 2030; 3%)
Proposal *(inventory impacts, costs and benefits reported below for the options are compared to the proposal)*					
	• 500 PPM in 2007 for NR, loco/marine • 15 ppm in 2010 NR only	• >25 hp: PM AT introduced 2013 • >75 hp: NOx AT introduced and phased-in 2011-2013 • <25 hp: PM stds in 2008 • 25-75 hp: PM stds in 2008 (optional for 50-75 hp)	Relative to baseline: 1,126,000 PM 4,952,000 SO2 5,591,000 NOx+NMHC	$16.7	$550[b]
1-Step Fuel Options					
1	• 15 ppm in 2008 for NR only • 500 ppm in 2008 for loco/marine	• < 50 hp: PM stds only in 2009 • 25-75 hp: PM AT stds and EGR or equivalent NOx technology in 2013; no NOx AT • >75 hp: PM AT stds phasing in beginning in 2009; NOx AT phasing in beginning in 2011	6,000 PM -191,000 SO2 11,000 NOx+NMHC	$1.7[d]	$.2[b]
1a	• 15 ppm in 2008 for NR, loco/marine	• PM AT introduced in 2009-10 • NOx AT introduced in 2011-12	129,000 PM -63,000 SO2 1,843,000 NOx+NMHC	a	$59
1b	• 15 ppm in 2006 for NR, loco/marine	Same as 1a	a		
2-Step Fuel Options					
2a	Same as proposal except – • 500 ppm in 2006 for NR, loco/marine	Same as proposal	18,000 PM 228,000 SO2 0 NOx+NMHC	a	$7[b]
2b	Same as proposal except – • 15 ppm in 2009 for NR	Same as proposal except – • Move PM AT up 1 year for all engines > 25 hp (phase in starts 2010)	54,000 PM 17,000 SO2 36,000 NOx+NMHC	$1.2[d]	$16[b]

Option	Fuel Standards	Engine Standards	Estimated Relative Inventory Impacts[c] (NPV tons thru 2030; 3% discount)	Estimated Cost Impacts - $Billion (NPV thru 2030; 3%)	Estimated Benefits Stream - $Billion[e] (NPV thru 2030; 3%)
2c	Same as proposal except – • 15 ppm in 2009 for NR	Same as proposal except – • Move PM AT up 1 year for all engines 175-750 hp (phase in starts 2010)	20,000 PM 17,000 SO2 16,000 NOx+NMHC	$0.8[d]	$6[b]
2d	• Same as proposal	Same as proposal except – • Phase-in NOx AT for 25-75hp beginning in 2013	0 PM 0 SO2 751,000 NOx+NMHC	a	$10[b]
Other Options					
3	• Same as proposal	Same as proposal except – • Mining equipment over 750 hp left at Tier 2	-30,000 PM 0 SO2 -751,000 NOx+NMHC	-$0.5	-$18[b]
4	Same as proposal except – • loco/marine fuel to 15 ppm in 2010	Same as proposal	9,000 PM 114,000 SO2 0 NOx+NMHC	$1.8	$6[b]
5a	• Same as proposal	Same as proposal except- • No Tier 4 standards <75 hp	-209,000 PM 0 SO2 -334,000 NOx+NMHC	-$3.8	-$70
5b	• Same as proposal	Same as proposal except- • No new <75hp standards after 2008 (i.e., no CDPFs in 2013)	-121,000 PM 0 SO2 -333,000 NOx+NMHC	-$2.6	-$43

Notes:

[a] Qualitative analysis only. Option is impractical due to infeasibility or other significant concerns. See the draft RIA for a detailed discussion

[b] By benefits transfer method

[c] Net Present (2004) Value impacts through 2030, using a 3% discount rate, relative to the proposed program. Positive values mean that the Option produces greater emission reductions from baseline than the proposed program.

[d] Cost estimates do not include the costs due to potential for limited product offerings and market disruptions in the engine/equipment and/or fuel markets. See Section V of this preamble and the draft FIA for a detailed discussion.

[e] Benefits do not include CO, VOC, air toxics, ozone, and PM welfare benefits. See Section V.F of this preamble and the draft RIA for additional discussion.

B. Introduction of 15 ppm Nonroad Diesel Sulfur Fuel in One Step

EPA carefully evaluated and is seeking comment on alternative regulatory approaches. Instead of the proposed two-step reduction in nonroad diesel sulfur, one alternative would require that the nonroad diesel sulfur level be reduced to 15ppm beginning June 1, 2008. This alternative would have the advantage of enabling use of high efficiency exhaust emission control technology for nonroad engines as early as the 2009 model year. It also would have several disadvantages which have prompted us not to propose it. The disadvantages in comparison to the proposal include inadequate lead-time for engine and equipment manufacturers and refiners, leading to increased costs and potential market disruptions. In this section, we describe this alternative in greater detail and discuss potential engine and fuel impacts. We also present our estimated emission and benefit impacts. Two other one-step fuel options which are variations of the alternative discussed in this section, Options 1a and 1b in Table VI–1, are presented in Chapter 12 of the draft RIA for this proposal.

1. Description of the One-Step Alternative

While numerous engine standards and phase-in schedules are possible, we considered the standards shown in Tables VI–2 and VI–3 as being the most stringent one-step program that could be considered potentially feasible considering cost, lead-time, and other factors. These standards are similar to those in our proposed option, the primary difference being the generally earlier phase-in dates for the PM standards.

TABLE VI–2.—PM STANDARDS FOR 1-STEP FUEL SCENARIO

[g/bhp–hr]

Engine power	Model year					
	2009	2010	2011	2012	2013	2014
hp < 25	0.30					
25 ≤ hp <50	10.22				0.02	
50 ≤ hp <75					0.02	
75 ≤ hp <175			0.01			
		[a] 50%	[a] 50%	[a] 100%		
175 ≤ hp <750		0.01				
	[a] 50%	[a] 50%	[a] 100%			
hp ≥ 750					0.01	
			[a] 50%	[a] 50%	[a] 50%	[a] 100%

Notes:
[a] Percentages are the model year sales required to comply with the indicated standard.

TABLE VI–3.—NO_X AND NMHC STANDARDS FOR 1-STEP FUEL SCENARIO

[g/bhp–hr]

Engine power	Model year			
	2011	2012	2013	2014
25 ≤ hp < 75			[a] 3.5	
75 ≤ hp <175		0.30 NO_X 0.14 NMHC		
		[b] 50%	[b] 50%	[b] 100%
175 ≤ hp <750	0.30 NO_X 0.14 NMHC			
	[b] 50%	[b] 50%	[b] 50%	[b] 100%
hp ≥750	0.30 NO_X 0.14 NMHC			
	[b] 50%	[b] 50%	[b] 50%	[b] 100%

Notes:
[a] A 3.5 NMHC + NO_X standard would apply to the 25–50 hp engines. Engines greater than 50hp are already subject to this standard in 2008 under the existing Tier 3 program.
[b] Percentages are the model year sales required to comply with the indicated standards.

2. Engine Emission Impacts

The main advantage associated with this one-step approach is pulling ahead the long-term PM engine standards. By making 15 ppm sulfur fuel widely available by late 2008, we could accelerate the long-term PM engine standards, leading to the introduction of precious metal catalyzed PM traps as early as 2009, two years earlier than possible under the two-step sulfur reduction approach. Some stakeholders have expressed the concern that a two-step approach leads to later than desired introduction of high-efficiency exhaust emissions controls on nonroad diesels because this cannot happen until the 15 ppm fuel standard goes into effect. As shown in Table VI–1, there would be additional public health benefits associated with this one-step approach. However, in comparison to the proposal, the additional benefits are relatively small, less than one percent or about $3 billion more than the proposed program.[295]

Even though 15 ppm fuel would be available beginning June 1, 2008 under this one-step approach, we do not believe it would be feasible to propose an aggressive turnover of new engines to trap-equipped versions in 2009. Nor would it be possible to introduce NO_X controls any earlier than we are already proposing, model year 2011. The proposed standards need to be coordinated with Tier 3 standards, and with the heavy duty highway diesel standards. The coordination of Tier 4 standards with Tier 3 standards and with the development of emissions control technology for highway diesel engines is of critical importance to successful implementation of the Tier 4 standards. Even those manufacturers who do not make highway engines are expected to gain substantially from the highway PM and NO_X control development work, provided they can plan for standards set at a similar level of stringency and timed in a way to allow for the orderly migration of highway engine technology to nonroad applications.

Thus, although the application of high-efficiency exhaust PM emission controls to nonroad diesels would be enabled with the introduction of 15 ppm sulfur nonroad fuel in 2008 under a one-step program, we believe that to require the application of PM controls across the wide spectrum of nonroad engines shortly thereafter would raise serious feasibility concerns that could only be resolved, if at all, through a very large additional R&D effort undertaken roughly in parallel with the similarly large highway R&D effort, a duplication of effort we wish to avoid for reasons discussed in Section III. Nonroad engine designers would need to accomplish much of this development well before the diesel experience begins to accumulate in earnest in 2007, in order to be ready for a 2009 first introduction date. Waiting until 2007 before initiating 2009 model year design work would risk the possibility of product failures, limited product availability and major market disruptions. At the same time, for those engine manufacturers who participate in both the highway and nonroad diesel engine markets, attempting to have concurrent engine product developments for highway and nonroad, could result in the possibility of product failures, limited product availability and major disruptions for the highway market as well. Thus, in balancing their costs and burden, many manufacturers may be forced to choose which products would be available for 2009 and which products would be delayed for release. Manufacturers would also incur large additional costs to redesign hundreds of engine models and thousand of machine types to meet Tier 4 standards only one to three years after Tier 3 standards take effect in 2006–2008. These cost impacts are reflected in Table VI–1 and their derivation is explained in chapter 12 of the draft RIA. This extra expenditure could only be modestly mitigated by phasing in the standards, since a crash R&D effort with limited benefit from highway experience would still be necessary.

Moreover, with respect to NO_X, it would be impractical or simply infeasible to pull the standards ahead on the same schedule. This is because EPA's highway diesel program allows manufacturers to phase in NO_X technology over 2007–2010. As a result, we do not expect that the high-efficiency NO_X control technology could reasonably be applied to nonroad engines any earlier under a one-step program than under a two-step program (*i.e.*, beginning in 2011).

In summary, this option would lead us to apply PM and NO_X standards in two different model years, or else forgo any opportunity to apply PM traps in 2009. Redesigning engines and emission controls for early PM control and then again a couple of years later for NO_X control, on top of shortened Tier 3 stability periods, would likely add substantial costs to the program. As manufacturers attempt to avoid these costs and optimize their development they may simply have to restrict product offerings for some period, leading to price spikes and shortages due to lack of product availability. Having the NO_X and PM standards phase in simultaneously under our proposed approach avoids cost and design stability issues for both engine and equipment manufacturers. In addition, the longer leadtime for the engine standards under our proposed program will allow greater economic efficiencies for engine manufacturers as they transfer highway emission reduction technology to nonroad engines.

3. Fuel Impacts

In addition to the challenges associated with pulling ahead the PM standards described above, there are also some concerns regarding the practicality of an early 15 ppm nonroad diesel sulfur standard. A one-step approach may result in several economic inefficiencies that would increase the cost of the program. For example, refiners will have little opportunity to take advantage of the newer desulfurization technologies currently being developed. As described in sections IV and V, refiners will only begin to be able to take advantage of these new technologies in 2008. By 2010, the ability to incorporate them into their refinery modifications is expected to double. If refiners have to take steps to reduce the sulfur content of nonroad diesel fuel earlier, they will likely have to use more expensive current technology. The cost impacts of this decision will persist, since the choice of technology is a long term decision. If a refiner is forced by the effective date of the standards to employ a more expensive technology, that choice will affect that refiner's output indefinitely, since the cost of upgrading to the new technologies will be prohibitive. As presented in section 5.2 of the Draft RIA, we estimate that the costs of achieving a 15 ppm standard in 2008 is approximately 0.4 c/gal greater than for the proposal. While difficult to quantify there are also considerable advantages to allowing refiners some operating time in producing 15 ppm diesel fuel for the highway program prior to requiring them to solidify their designs for producing nonroad diesel fuel to 15 ppm. The primary advantage is that the design of desulfurization equipment used to produce 15 ppm nonroad diesel fuel can reflect the operating experience of the equipment used to produce 15 ppm highway diesel fuel starting in 2006. This extra time would also provide current refiners of high sulfur diesel fuel with highly confident estimates of the cost of producing 15 ppm diesel fuel, reducing uncertainty and increasing their likelihood of investing to produce this fuel. With a start date of June 1, 2008 refiners would have to solidify their designs and start construction prior to getting any data on the performance of their highway technology. This would increase the cost of producing 15 ppm nonroad diesel fuel for the life of the new desulfurization equipment, as well as potentially delaying some refiners' decision to invest in new desulfurization equipment due to uncertainties in cost, performance, etc.

[295] A variation on this one-step approach would be to also require the sulfur content of locomotive and marine fuel to meet the 15 ppm standard in 2008. The decision of whether or not to require the sulfur content of locomotive and marine fuel to also be reduced to 15 ppm, however, is not unique to the one step approach, and, as discussed below is an alternative also being evaluated under our proposed 2-step program. Were we to require locomotive and marine diesel fuel to also meet the 15 ppm standard in 2008 under a one-step approach, there would be additional inventory reductions of about 10,000 tons of PM and 128,000 tons of SO_3 (NPV 3% through 2030).

4. Emission and Benefit Impacts

We used the nonroad model to estimate the emission inventory impacts associated with this one-step option, as well as the other options listed in Table VI–1. As for all the alternatives, we then used the benefits transfer method to estimate the monetized benefits of the alternative.[296] The results are shown in Table VI–1. As is evidenced by the values in Table VI–1, the one-step alternative would achieve slightly greater PM and NO_X emission reductions through 2030 than the proposed 2-step program, with 6,000 and 11,000 additional tons reduced, respectively (or less than 0.5 percent). Unlike the proposed 2-step program, however, there would be no SO_2 emission reductions in 2007 due to the delay in fuel sulfur control, although 2009 and later emission are slightly greater due primarily to the earlier introduction of engines using PM filters. Nevertheless, the SO_2 benefits of the one-step program are slightly less than the proposed 2-step program in the long run, by about 191,000 tons (about 4 percent) through 2030.

After careful consideration of these matters, we have decided to propose the two-step approach in today's notice. The two-step program avoids adverse risks to the smooth implementation of the entire Tier 4 nonroad program that could be caused by the significantly shortened lead-time and stability of the one-step program. There are also concerns about the potential negative impacts the one-step option may have on the 2007 highway program, including the implications of the overlap of implementation schedules (see above and Chapter 12 of the draft RIA). Nevertheless, we believe that the one-step approach is a regulatory alternative worth considering. In addition to seeking comment on our proposed program, we also seek comment on the relative merits and shortcomings of a one-step approach to regulating nonroad diesel fuel and the associated schedule for implementing the engine standards.

C. Applying 15 ppm Requirement to Locomotive and Marine Diesel Fuel

To enable the high efficiency exhaust emission control technology to begin to be applied to nonroad diesel engines beginning with the 2011 model year, we are proposing that all nonroad diesel fuel produced or imported after June 1, 2010 would have to meet a 15 ppm sulfur cap. Although locomotive and marine diesel engines are similar in size to some of the diesel engines covered in this proposal, there are many differences that have caused us to treat them separately in past EPA programs.[297] These include differences in duty cycles and exhaust system design configurations, size, and rebuild and maintenance practices. Because of these differences, we are not proposing new engine standards today for these engine categories. Since we are not proposing more stringent emission standards, we are also not proposing that the second step of sulfur control to 15 ppm in 2010 be applied to locomotive and marine diesel fuel. Instead, we are proposing to set a sulfur fuel content standard of 500 ppm for diesel fuel used in locomotive and marine applications. This fuel standard is expected to provide considerable sulfate PM and SO_2 benefits even without establishing more stringent emission standards for these engines. We estimate that, cumulatively through 2030, reducing the sulfur content of locomotive and marine diesel fuel would eliminate about 102,000 tons of sulfate PM (net present value, based on a 3 percent discount rate).

As discussed in section IV, we are seriously considering the option of extending the 15 ppm sulfur standard to locomotive and marine fuel as early as June 1, 2010, including them in the second step of the proposed two-step program. There are several advantages associated with this alternative. First, as reflected in Table VI–1, it would provide important additional sulfate PM and SO_2 emission reductions and the estimated benefits from these reductions would outweigh the costs by a considerable margin. Second, in some ways it would simplify the fuel distribution system and the design of the fuel program proposed today since a marker would not be required for locomotive and marine diesel fuel. Furthermore, the prices for locomotive and marine diesel fuel may be virtually unaffected. Under the proposal, we expect that a certain amount of marine fuel will be 15 ppm sulfur fuel regardless of the standard due to limitations in the production and distribution of unique fuel grades. Where 500 ppm fuel is available, the possible suppliers of fuel will likely be more constrained, limiting competition and allowing prices to approach that of 15 ppm fuel. If we were to bring locomotive and marine fuel to 15 ppm, the pool of possible suppliers could expand beyond those today, since highway diesel fuel will also be at the same standard. Third, it would help reduce the potential opportunity for misfueling of 2007 and later model year highway vehicles and 2011 and later model year nonroad equipment with higher sulfur fuel. Finally, it would allow refiners to coordinate plans to reduce the sulfur content of all of their nonroad, locomotive, and marine diesel fuel at one time. While in many cases this may not be a significant advantage, it may be a more important consideration here since it is probably not a question of whether locomotive and marine fuel must meet a 15 ppm cap, but merely when. As discussed in section IV, it is the Agency's intention to propose action in the near future to set new emission standards for locomotive and marine engines that could require the use of high efficiency exhaust emission control technology, and thus, also require the use of 15 ppm sulfur diesel fuel.[298] We anticipate that such engine standards would likely take effect in the 2011–13 timeframe, requiring 15 ppm locomotive and marine diesel fuel in the 2010–12 timeframe. We intend to publish an advance notice of proposed rulemaking for such standards by the Spring of 2004 and finalize those standards by 2007.

However, discussions with refiners have suggested there are significant advantages to leaving locomotive and marine diesel fuel at 500 ppm, at least in the near-term and until we set more stringent standards for those engines. The locomotive and marine diesel fuel markets could provide an important market for off-specification product, particularly during the transition to 15 ppm for highway and nonroad diesel fuel in 2010. Waiting just a year or two beyond 2010 would address the critical near-term needs during the transition. In addition, waiting just another year or two beyond 2010 is also projected to allow virtually all refiners to take advantage of the new lower cost technology.

After careful consideration of these matters, we have decided not to propose

[296] The results that were obtained for Option 1a were extrapolated based on the emission inventory changes to the proposed program and were obtained for the other alternatives by assuming the air quality changes between the alternative and the actual case run were small enough to allow for such extrapolation. An explanation of the benefits transfer method is contained in Chapter 9 of the draft RIA.

[297] Locomotives, in fact, are treated separately from other nonroad engines and vehicles in the Clean Air Act, which contains provisions regarding them in section 213(a)(5). Less than 50 hp marine engines were included in the 1998 final rule for nonroad diesel engines, albeit with some special provisions to deal with marine-specific engine characteristics and operating cycles.

[298] EPA established the most recent new standards for locomotives and marine diesel engines (including those under 50 hp) in separate actions (63 FR 18977, April 16, 1998, and 67 FR 68241, November 8, 2002).

to apply the second step of sulfur control of 15 ppm to locomotive and marine diesel fuel at this time. Nevertheless, for the reasons described above, we are carefully weighing whether it would be appropriate to do so. Therefore, we seek comment on this alternative and the various advantages, disadvantages, and implications of it.

D. Other Alternatives

We have also analyzed a number of other alternatives, as summarized in Table VI–1. Some of these focus on control options more stringent than our proposal while others reflect modified engine requirements that result in less stringent control. EPA has evaluated these options in terms of the feasibility, emissions reductions, costs, and other relevant factors. EPA believes the proposed approach is the proper one with respect to these factors, and believes the options discussed above while having possible merit in some areas, raise what we believe are different and significant concerns with respect to these factors compared to the proposed approach. Hence we did not include these options. These concerns are discussed in more detail in Chapter 12. These concerns are discussed in more detail in Chapter 12 of the draft RIA. Hence, we did not include these options as part of our proposal for nonroad fuel and engine controls. We are interested in comment on these alternatives, especially information regarding their feasibility, costs, and other relevant concerns.

VII. Requirements for Engine and Equipment Manufacturers

This section describes the regulatory changes proposed for the engine and equipment compliance program. First, the proposed regulations for Tier 4 engines have been written in plain language. They are structured to contain the provisions that are specific to nonroad CI engines in a new proposed part 1039, and to apply the general provisions of existing parts 1065 and 1068. The proposed plain language regulations, however, are not intended to significantly change the compliance program, except as specifically noted in today's notice (and we are not soliciting comment on any part of the rule that remains unchanged substantively). As proposed, these plain language regulations would only apply for Tier 4 engines. The changes from the existing nonroad program are described below along with other notable aspects of the compliance program.

A. Averaging, Banking, and Trading

1. Are We Proposing To Keep the ABT Program for Nonroad Diesel Engines?

EPA has included averaging, banking, and trading (ABT) programs in most mobile source emission control programs adopted in recent years. Our existing regulations for nonroad diesel engines include an ABT program (§ 89.201 through § 89.212). We are proposing to retain the basic structure of the existing nonroad diesel ABT program with today's notice, though we are proposing a number of changes to accommodate implementation of the proposed emission standards. Behind these changes is the recognition that the proposed standards represent a major technological challenge to the industry. The proposed ABT program is intended to enhance the ability of engine manufacturers to meet the stringent standards proposed today. The proposed program is also structured to limit production of very high-emitting engines and to avoid unnecessary delay of the transition to the new exhaust emission control technology.

We view the proposed ABT program as an important element in setting emission standards that are appropriate under CAA section 213 with regard to technological feasibility, lead time, and cost. The ABT program helps to ensure that the stringent standards we are proposing are appropriate under section 213(a) given the wide breadth and variety of engines covered by the standards. For example, if there are engine families that will be particularly costly or have a particularly hard time coming into compliance with the standard, this flexibility allows the manufacturer to adjust the compliance schedule accordingly, without special delays or exceptions having to be written into the rule. Emission-credit programs also create an incentive (for example, to generate credits in early years to create compliance flexibility for later engines) for the early introduction of new technology, which allows certain engine families to act as trailblazers for new technology. This can help provide valuable information to manufacturers on the technology before they apply the technology throughout their product line. This early introduction of clean technology improves the feasibility of achieving the standards and can provide valuable information for use in other regulatory programs that may benefit from similar technologies. Early introduction of such engines also secures earlier emission benefits.

In an effort to make information on the ABT program more available to the public, we intend to issue periodic reports summarizing use of the proposed ABT program by engine manufacturers. The information contained in the periodic reports would be based on the information submitted to us by engine manufacturers, and summarized in a way that protects the confidentiality of individual engine manufacturers. We believe this information will also be helpful to engine manufacturers by giving them a better indication of the availability of credits. Again, our periodic reports would not contain any confidential information submitted by individual engine manufacturers, such as sales figures. Also, the information would be presented in a format that would not allow such confidential information to be determined from the reports.

2. What Are the Provisions of the Proposed ABT Program?

The following section describes the changes proposed to the existing ABT program. In addition to those areas specifically highlighted, we are soliciting comments on all aspects of the proposed ABT changes, including comments on the need for and benefit of these changes to manufacturers in meeting the proposed emission standards.

The ABT program has three main components. Averaging means the exchange of emission credits between engine families within a given engine manufacturer's product line. (Engine manufacturers divide their product line into ''engine families'' that are comprised of engines expected to have similar emission characteristics throughout their useful life.) Averaging allows a manufacturer to certify one or more engine families at levels above the applicable emission standard, but below a set upper limit. However, the increased emissions must be offset by one or more engine families within that manufacturer's product line that are certified below the same emission standard, such that the average emissions from all the manufacturer's engine families, weighted by engine power, regulatory useful life, and production volume, are at or below the level of the emission standard. (The inclusion of engine power, useful life, and production volume in the averaging calculations is designed to reflect differences in the in-use emissions from the engines.) Averaging results are calculated for each specific model year. The mechanism by which this is accomplished is certification of the engine family to a ''family emission limit'' (FEL) set by the manufacturer, which may be above or below the standard. An FEL that is established above the standard may not exceed an upper limit specified in the ABT regulations. Once an engine family is certified to an FEL, that FEL becomes the enforceable emissions limit for all the engines in that family for purposes of compliance testing. Averaging is allowed only between engine families in the same averaging set, as defined in the regulations.

Banking means the retention of emission credits by the engine manufacturer for use in future model year averaging or trading. Trading means the exchange of emission credits between nonroad diesel engine manufacturers which can then be used for averaging purposes, banked for future use, or traded to another engine manufacturer.

The existing ABT program for nonroad diesel engines covers NMHC+NO_X emissions as well as PM emissions. With today's notice we are proposing to make the ABT program available for the proposed NO_X standards and proposed PM standards. (For engines less than 75 horsepower where we are proposing combined NMHC+NO_X standards, the ABT program would continue to be available for the proposed NMHC+NO_X standards as well as the proposed PM standards.) ABT would not be available for the proposed NMHC standards for engines above 75 horsepower or for the proposed CO standards for any engines.

As noted earlier, the existing ABT program for nonroad diesel engines includes FEL caps—limits on how high the emissions from credit-using engine families can be. No engine family may be certified above these FEL caps. These limits provide the manufacturers compliance flexibility while protecting against the introduction of unnecessarily high-emitting engines. When we propose new standards, we typically propose new FEL caps for the new standards. In the past, we have generally set the FEL caps at the emission levels allowed by the previous standard, unless there was some specific reason to do otherwise. We are proposing to do otherwise here because the proposed standard levels in today's notice are so much lower than the current standards levels, especially the Tier 4 standards for engines above 75 horsepower. The transfer to new technology is feasible and appropriate. Thus, to ensure that the ABT provisions are not used to continue producing old-technology high-emitting engines under the new program, the proposed FEL caps would not, in general, be set at the previous standards. An exception is for the proposed NMHC+NO_X standard for engines between 25 and 50 horsepower effective in model year 2013, where we are proposing to use the previously applicable NMHC+NO_X standard for the FEL cap since the gap between the previous and proposed standards is approximately 40 percent (rather than 90 percent for engines above 75 horsepower).

For engines above 75 horsepower certified during the phase-in period, there would be two separate sets of engines with different FEL caps. For engines certified to the existing (Tier 3) NMHC+NO_X standards during the phase-in, the FEL cap would necessarily continue to be the existing FEL caps as adopted in the October 1998 rule. For engines certified to the proposed Tier 4 NO_X standard during the phase-in, the FEL cap would be 3.3 g/bhp-hr for engines between 75 and 100 horsepower, 2.8 g/bhp-hr for engines between 100 and 750 horsepower, and 4.6 g/bhp-hr for engines above 750 horsepower. These proposed NO_X FEL caps represent an estimate of the NO_X emission level that is expected under the combined NMHC+NO_X standards that apply with the existing previous tier standards. Beginning in model year 2014 when the proposed Tier 4 NO_X standard for engines above 75 horsepower take full effect, we are proposing a NO_X FEL cap of 0.60 g/bhp-hr for engines above 75 horsepower. (As described below, we are proposing to allow a small number of engines greater than 75 horsepower to have NO_X FELs above the 0.60 g/bhp-hr cap beginning in model year 2014.) Given the fact that the proposed Tier 4 NO_X standard is approximately a 90 percent reduction from the existing standards for engines above 75 horsepower, we do not believe the previous standard would be appropriate as the FEL cap for all engines once the Tier 4 standards are fully phased-in. We believe that the proposed NO_X FEL caps will ensure that manufacturers adopt NO_X aftertreatment technology across all of their engine designs (with the exception of a limited number) but will also allow for some meaningful use of averaging during the phase-in period. When compared to the proposed 0.30 g/bhp-hr NO_X standard, the proposed NO_X FEL cap of 0.60 g/bhp-hr (effective when the Tier 4 standards are fully phased-in) is consistent with FEL caps set in previous rulemakings.

For the transitional PM standards being proposed for engines between 25 and 75 horsepower effective in model year 2008 and for the Tier 4 PM standards for engines below 25 horsepower, we are proposing the previously applicable Tier 2 PM standards (which do vary within the 25 to 75 horsepower category) for the FEL caps since the gap between the previous and proposed standards is approximately 50 percent (rather than in excess of 90 percent for engines above 75 horsepower). For the proposed Tier 4 PM standard effective in model year 2013 for engines between 25 and 75 horsepower, we are proposing a PM FEL cap of 0.04 g/bhp-hr, and for the proposed Tier 4 PM standard effective in model years 2011 and 2012 for engines between 75 and 750 horsepower, we are proposing a PM FEL cap of 0.03 g/bhp-hr. (As described below, we are proposing to allow a small number of Tier 4 engines greater than 25 horsepower to have PM FELs above these caps.) Given the fact that the proposed Tier 4 PM standards for engines above 25 horsepower are less than 10 percent of the previous standards, we do not believe the previous standards would be appropriate as FEL caps once the Tier 4 standards take effect. We believe that the proposed PM FEL caps will ensure that manufacturers adopt PM aftertreatment technology across all of their engine designs (except for a limited number of engines), yet will still provide substantial flexibility in meeting the standards.

For the proposed Tier 4 PM standards for engines above 750 horsepower there is a phase-in period during model years 2011 through 2013. During the phase-in period, there would be two separate sets of engines with different FEL caps. For engines certified to the existing Tier 2 PM standard, the FEL cap would continue to be the existing PM FEL cap adopted in the October 1998 rule. For engines certified to the proposed Tier 4 PM standard during the phase-in, the FEL cap would be 0.15 g/bhp-hr (the PM standard for the previous tier). Beginning in model year 2014, when the proposed Tier 4 PM standard for engines above 750 horsepower takes full effect, consistent with the proposed caps for lower horsepower categories, we are proposing a PM FEL cap of 0.03 g/bhp-hr. (As described below, we are proposing to allow a small number of engines greater than 750 horsepower to have PM FELs above the 0.03 g/bhp-hr cap beginning in model year 2014.) We believe that the proposed PM FEL caps for engines above 750 horsepower will ensure that manufacturers adopt PM aftertreatment technology across all of their engine designs once the standard is fully phased-in (with the exception of a limited number) while allowing for some meaningful use of averaging during the phase-in period.

Table VII.A–1 contains the proposed FEL caps and the effective model year for the FEL caps (along with the associated standards proposed for Tier 4). We request comment on the need for and the levels of these proposed FEL caps. It should be noted that for Tier 4, where we are proposing a new transient test, as well as retaining the current steady-state test, the FEL established by the engine manufacturer would be used as the enforceable limit for the purpose of compliance testing under both test cycles. In addition, under the NTE requirements, the FEL times the appropriate multiplier would be used as the enforceable limit for the purpose of such compliance testing.

TABLE VII.A–1.—PROPOSED FEL CAPS FOR THE PROPOSED TIER 4 STANDARDS IN THE ABT PROGRAM

[g/bhp-hr]

Power category	Effective model year	NO_X standard	NO_X FEL cap	PM standard	PM FEL cap
hp < 25 (kW < 19)	2008+	([a])	([a])	[b] 0.30	0.60
25 ≤ hp < 50 (19 ≤ kW < 37)	2008–2012	([a])	([a])	0.22	0.45
25 ≤ hp < 50 (19 ≤ kW < 37)	2013+[d]	[e] 3.5	5.6 [e]	0.02	[f] 0.04
50 ≤ hp < 75 (37 ≤ kW < 56)	2008–2012	([a])	([a])	0.22	0.30
50 ≤ hp < 75 (37 ≤ kW < 56)	2013+	([a])	([a])	0.02	[f] 0.04
75 ≤ hp <175 (56 ≤ kW <130)	2012–2013 [g]	0.30	3.3 for hp < 100 2.8 for hp ≥ 100.	0.01	[f] 0.03
75 ≤ hp <175 (56 ≤ kW <130)	2014+	0.30	0.60 [f]	0.01	[f] 0.03
175 ≤ hp ≤750 (130 ≤ kW ≤560)	2011–2013	0.30	2.8	0.01	[f] 0.03
175 ≤ hp ≤750 (130 ≤ kW ≤560)	2014+	0.30	0.60 [f]	0.01	[f] 0.03
hp >750 (kW >560)	2011–2013	0.30	4.6	0.01	0.15
hp >750 (kW >560)	2014+	0.30	0.60 [f]	0.01	[f] 0.03

Notes:

[a] The existing NMHC+NO_X standard and FEL cap apply (see CFR Title 40, section 89.112).

[b] A PM standard of 0.45 g/bhp-hr would apply to air-cooled, hand-startable, direct injection engines under 11 horsepower, effective in 2010.

[c] The proposed FEL caps do not apply if the manufacturer elects to comply with the optional standards. The existing FEL caps continue to apply.

[d] FEL caps apply in model year 2012 if the manufacturer elects to comply with the optional standards.

[e] These are a combined NMHC+NO_X standard and FEL cap.

[f] As described in this section, a small number of engines are allowed to exceed these FEL caps.

[g] This period would extend through the first nine months of 2014 under the alternative, reduced phase-in requirement (see Section III.B.1. for a description of the proposed alternative).

As noted above, we are proposing to allow a limited number of engines to have a higher FEL than the caps noted in Table VII.A–1 in certain instances. Under this proposal, the allowance to certify up to these higher FEL caps would apply to Tier 4 engines at or above 25 horsepower. The provisions are intended to provide some limited flexibility for engine manufacturers as they transition to the stringent standards while ensuring that the vast majority of engines are converted to the advanced low-emission technologies expected under the Tier 4 program. This additional lead time appears appropriate, given the potential that a limited set of nonroad engines may face especially challenging difficulties in complying, and considering further that the same amount of overall emission reductions would be achieved through the need for credit-generating nonroad engines.

Beginning the first year Tier 4 standards apply in each power category above 25 horsepower, an engine manufacturer would be allowed to certify up to ten percent of its engines in each power category with PM FELs above the caps shown in Table VII.A–1. The PM FEL cap for such engines would instead be the applicable previous tier PM standard. The ten percent allowance would be available for the first four years the Tier 4 standards apply. For the power categories in which we are proposing a phase-in requirement for the Tier 4 NO_X standards, the allowance to use a higher FEL cap would apply only to PM during the phase-in years. Once the phase-in period is complete, the allowance would apply to NO_X as well. (For engines above 750 horsepower, where we are proposing a phase-in for both NO_X and PM, the allowance to use a higher FEL cap would not take effect until model year 2014 when the phase-in was complete.)

After the fourth year the Tier 4 standards apply, the allowance to certify engines using the higher FEL caps would still be available but for no more than five percent of a manufacturer's engines in each power category. (For the power category between 25 and 75 horsepower, this allowance would apply beginning with the 2013 model year and would apply to PM. The allowance to use the higher FEL caps is not necessary for the 2008 proposed standards or the 2013 proposed NMHC+NO_X standards because the FEL caps for those standards are set at the previously applicable tier standards.)

Table VII.A–2 presents the model years, percent of engines, and higher FEL caps that would apply under this allowance. Because the engines certified with the higher FEL caps are certified to the Tier 4 standards (albeit through the use of credits), they would be considered Tier 4 engines and all other requirements for Tier 4 engines would also apply, including the Tier 4 NMHC standard. We invite comment on whether additional provisions may be necessary for the limited number of engines certified to the higher FELs, including whether an averaging program for NMHC would be needed.

TABLE VII.A–2.—ALLOWANCE FOR LIMITED USE OF AN FEL CAP HIGHER THAN THE TIER 4 FEL CAPS

Power category	Model years	Engines allowed to have higher FELs	NO_X FEL cap (g/bhp-hr)	PM FEL cap (g/bhp-hr)
25 ≤ hp <75 (19 ≤ kW < 56)	2013–2016	10	Not applicable	0.22.
	2017+	5		
75 ≤ hp <175 (56 ≤ kW <130)	2012–2013[a]	10	Not applicable	0.30 for hp <100.
	2014–2015	10	3.3 for hp <100	0.22 for hp ≥100.
	2016+	5	2.8 for hp ≥100	
175 ≤ hp ≤750 (130 ≤ kW ≤ 560)	2011–2013	10	Not applicable	0.15.
	2014	10	2.8	
	2015+	5		
hp >750 (kW > 560)	2014–2017	10	4.6	0.15.
	2018+	5		

[a] This period would extend through the first nine months of 2014 under the alternative, reduced phase-in requirement (see Section III.B.1. for a description of the proposed alternative).

We request comment on the proposed provisions to allow higher FELs on a limited number of Tier 4 engines, including whether the proposed allowance limits of 10 percent and 5 percent have been set at the right levels and whether the allowance to use a higher FEL cap is appropriate for the Tier 4 program. We also request comment on allowing manufacturers to use the allowances in a slightly different manner over the first four years. Instead of allowing manufacturers to certify up to ten percent for each of the first four years, manufacturers could certify up to 40 percent of one year's production but spread it out over four years in an unequal manner (*e.g.*, 15 percent in the first and second years, and 5 percent in the third and fourth years). Last of all, we request comment on whether the allowance should be available for NO_X during the years we a proposing a phase-in for the Tier 4 NO_X standards. As proposed, we would not cover NO_X during the phase-in years because manufacturers already can certify up to 50 percent of their engines to the Tier 3 NMHC+NO_X standards.

Under the proposed Tier 4 program, for engines above 75 horsepower there will be two different groups of engines during the phase-in period. In one group, engines would certify to the applicable Tier 3 NMHC+NO_X standard (or Tier 2 standard for engines above 750 horsepower), and would be subject to the ABT restrictions and allowances previously established for those tiers. In the other group, engines would certify to the 0.30 g/bhp-hr NO_X standard, and would be subject to the restrictions and allowances in this proposed program. While engines in each group are certified to different standards, we are proposing to allow manufacturers to transfer credits across these two groups of engines with the following adjustment. As proposed, manufacturers could use credits generated during the phase-out of engines subject to the Tier 3 NMHC+NO_X standard (or Tier 2 NMHC+NO_X standard for engines above 750 horsepower) to average with engines subject to the 0.30 g/bhp-hr NO_X standard, but these credits will be subject to a 20 percent discount. In other words, each gram of NMHC+NO_X credits from the phase-out engines would be worth 0.8 grams of NO_X credits in the new ABT program. The ability to average credits between the two groups of engines will give manufacturers a greater opportunity to gain experience with the low-NO_X technologies before they are required to meet the final Tier 4 standards across their full production. (The 20 percent discount would also apply to NMHC+NO_X credits generated on less than 75 horsepower engines and used for averaging purposes with the NO_X standards for engines greater than 75 horsepower.)

We are proposing the 20 percent discount for two main reasons. First, the discounting addresses the fact that NMHC reductions can provide substantial NMHC+NO_X credits, which are then treated as though they were NO_X credits. For example, a 2010 model year engine (between 175 and 750 horsepower) emitting at 2.7 g/bhp-hr NO_X and 0.3 g/bhp-hr NMHC meets the 3.0 g/bhp-hr NMHC+NO_X standard in that year, but gains no credits. In 2011, that engine, equipped with a PM trap to meet the new PM standard, will have very low NMHC emissions because of the trap, an emission reduction already accounted for in our assessment of the air quality benefit of this program. As a result, without substantially redesigning the engine to reduce NO_X or NMHC, the manufacturer could garner a windfall of nearly 0.3 g/bhp-hr of NMHC+NO_X credit for each of these engines produced. (Engines designed at lower NO_X levels than this in 2010 can gain even more credits.) Allowing these NMHC-derived credits to be used undiscounted to offset NO_X emissions on the phase-in engines in 2011 (for which each 0.1 g/bhp-hr of margin can make a huge difference in facilitating the design of engines to meet the 0.30 g/bhp-hr NO_X standard) would be inappropriate. Second, the discounting would work toward providing a net environmental benefit from the ABT program, such that the more that manufacturers use banked and averaged credits, the greater the potential emission reductions overall.

Some foreign engine manufacturers have commented that it is difficult for them to accurately predict the number of engines that eventually end up in the U.S., especially when they sell to a number of different equipment manufacturers who may import equipment. This would make it difficult for the engine manufacturer to ensure they are complying with the proposed NO_X phase-in requirements for engines above 75 horsepower and the proposed PM phase-in requirements for engines above 750 horsepower. Therefore, we are proposing to allow engine manufacturers to demonstrate compliance with the NO_X phase in requirements for engines above 75 horsepower and the PM phase in requirements for engines above 750 horsepower by certifying ''split'' engine families (*i.e.*, an engine family that is split into two equal-sized subfamilies, one that generates a number of credits and one that uses an equal number of credits). In order to facilitate compliance with the proposed standards, we are proposing that this option be available to all engine manufacturers (*i.e.*, both foreign and domestic manufacturers). Manufacturers would be allowed to certify split engine families with FELs no higher than the levels specified in Table VII.A–3. The maximum NO_X FEL values specified in Table VII.A–3 were set at the level which would result in NO_X ABT credits from engines above the Tier 4 standards offsetting ABT credits from engines below the previously applicable NMHC+NO_X standards, including the 20 percent discount for using NMHC+NO_X credits on Tier 4 engines. The maximum PM FEL value for engines above 750 horsepower was set at the level halfway between the Tier 2 and proposed Tier 4 PM standard for engines above 750 horsepower. Manufacturers certifying split engine families would exclude those engines from end of the year ABT calculations (and therefore would not need to determine actual U.S. sales of such engine families for ABT credit calculation purposes). Manufacturers certifying split engine families would also exclude those engines from the calculations demonstrating compliance with the phase-in percentage requirements as well.

TABLE VII.A–3.—MAXIMUM FEL FOR ENGINE FAMILIES CERTIFIED AS ''SPLIT'' ENGINE FAMILIES

Power category	Pollutant	Maximum FEL, g/bhp-hr
75 ≤ hp >175 (56 ≤ kW <130).	NO_X	[a] 1.7
175 ≤ hp ≤750 (130 ≤ kW <560).	NO_X	1.5
hp >750 (kW >560).	NO_X	2.3
hp >750 (kW >560).	PM	0.08

Notes:
[a] A limit of 2.5 g/bhp-hr would apply under the alternative, reduced phase-in requirement (see Section III.B.1. for a description of the proposed alternative).

We are proposing one additional restriction on the use of credits under the ABT program. For the proposed Tier 4 standards we are proposing that manufacturers may only use credits generated from other Tier 4 engines or from engines certified to the previous tier of standards (*i.e.*, Tier 2 for engines below 50 horsepower, Tier 3 for engines between 50 and 750 horsepower, and Tier 2 engines above 750 horsepower). (As discussed in more detail below, we are proposing slightly different restrictions on the use of previous tier credits for engines between 75 and 175 horsepower.) We currently have a similar provision that prohibits the use of Tier 1 credits to demonstrate Tier 3 compliance, and given the levels of the final Tier 4 standards being proposed today, we believe it is appropriate to apply a similar restriction. Otherwise, we would be concerned about the possibility that credits from engines certified to relatively high standards could be used to significantly delay the implementation of the final Tier 4 program and its benefits.

For reasons explained in Section III.B.1.b. of today's notice, we are proposing unique phase-in requirements for engines between 75 and 175 horsepower in order to ensure appropriate lead time for these engines. Because of these unique phase-in provisions for engines between 75 and 175 horsepower, we are proposing slightly different provisions regarding the use of previous-tier credits. Under this proposal, manufacturers that choose to demonstrate compliance with the proposed phase-in requirements (*i.e.*, 50 percent in 2012 and 2013 and 100 percent in 2014) would be allowed to use Tier 2 NMHC+NO_X credits generated by engines above 50 horsepower (along with any other allowable credits) to demonstrate compliance with the Tier 4 standards for engines between 75 and 175 horsepower during model years 2012, 2013 and 2014 only. These Tier 2 credits would be subject to the power rating conversion already established in our ABT program, and to the 20% credit adjustment we are proposing for use of NMHC+NO_X credits as NO_X credits. Manufacturers that choose to demonstrate compliance with the optional reduced phase-in requirement for engines between 75 and 175 horsepower, would not be allowed to use Tier 2 credits generated by engines above 50 horsepower to demonstrate compliance with the Tier 4 standards. (Use of credits other than banked Tier 2 credits from engines above 50 horsepower would still be allowed, in accordance with other ABT program provisions.) In addition, manufacturers choosing the reduced phase-in option would not be allowed to generate NO_X credits from engines in this power category in 2012, 2013, and the first 9 months of 2014, except for use in averaging within this power category (*i.e.*, no banking or trading, or averaging with engines in other power categories would be permitted). This restriction would apply throughout this period even if the reduced phase-in option is exercised during only a portion of this period. We believe that this restriction is important to avoid potential abuse of the added flexibility allowance, considering that larger engine categories will be required to demonstrate substantially greater compliance levels with the 0.30 g/bhp-hr NO_X standard several years earlier than engines built under this option.

Under this proposal, we are not proposing any averaging set restrictions for Tier 4 engines. An averaging set is a group of engines, defined by EPA in the regulations, within which manufacturers may use credits under the ABT program. In the current nonroad diesel ABT program, there are averaging set restrictions. The current averaging sets consist of engines less than 25 horsepower and engines greater than or equal to 25 horsepower. The restriction was adopted because of concerns over the ability of manufacturers to generate significant credits from the existing engines and use the credits to delay compliance with the newly adopted standards. (*See* 63 FR 56977.) We believe the proposed Tier 4 standards are sufficiently protective to limit the ability of manufacturers to generate significant credits from their current engines. In addition, we believe the proposed FEL caps provide sufficient assurance that low-emissions technologies will be introduced in a timely manner. Therefore, under this proposal, averaging would be allowed between all engine power categories without restriction effective with the Tier 4 standards. The averaging set restriction placed on credits generated from Tier 2 and Tier 3 engines would continue to apply if they are used to demonstrate compliance for Tier 4 engines.

As described in section III.B.1.d.i. of today's notice, we are also proposing a separate PM standard for air-cooled, hand-startable, direct injection engines under 11 horsepower. In order to avoid potential abuse of this standard, engines certified under this proposed requirement would not be allowed to generate credits as part of the ABT program. Credit use by these engines would be allowed. The restriction should be no burden to manufacturers, as it would apply only to those air-cooled, hand-startable, direct injection engines under 11 horsepower that are certified under the special standard, and the production of credit-generating engines would be contrary to the standard's purpose.

The current ABT program contains a restriction on trading credits generated from indirect injection engines greater than 25 horsepower. The restriction was originally adopted because of concerns over the ability of manufacturers to generate significant credits from existing technology engines. (*See* 63 FR 56977.) Under this proposal, we are not proposing the restriction which prohibits manufacturers from trading credits generated on Tier 4 indirect fuel injection engines greater than 25 horsepower. Based on the certification levels of indirect injection engines, we do not believe there is the potential for manufacturers to generate significant credits from their currently certified engines against the proposed Tier 4 standards. Therefore, we are not proposing to restrict the trading of credits generated on Tier 4 indirect injection engines to other manufacturers. The restriction placed on the trading of credits generated from Tier 2 and Tier 3 indirect injection engines would continue to apply in the Tier 4 timeframe.

We are not proposing to apply a specific discount to Tier 3 PM credits used to demonstrate compliance with the Tier 4 standards. PM credits generated under the Tier 3 standards are based on testing performed over a steady-state test cycle. Under the proposed Tier 4 standards, the test cycle is being supplemented with a transient test (*see* Section III.C above and VII.F below). Because in-use PM emissions from Tier 3 engines will vary depending on the type of application in which the engine is used (some having higher in-use PM emissions, some having lower in-use PM emissions), the relative ''value'' of the Tier 3 PM credits in the Tier 4 timeframe will differ. Instead of requiring manufacturers to gather information to estimate the level of in-use PM emissions compared to the PM level of the steady-state test, we believe allowing manufacturers to bring Tier 3 PM credits directly into the Tier 4 time frame without any adjustment is appropriate because it discounts their value for use in the Tier 4 timeframe (since the initial baseline being reduced is probably higher than measured in the Tier 2 test procedure).

3. Should We Expand the Nonroad ABT Program To Include Credits From Retrofit of Nonroad Engines?

We are considering expanding the scope of the standards by setting voluntary new engine standards applicable to the retrofit of nonroad diesel engines, and allowing these nonroad diesel engines to generate PM and NO_X credits available for use by other nonroad diesel engines. This program could achieve greater emission reductions of these pollutants than could otherwise be achieved, in a cost-effective manner. Specifically, we would allow existing in-use nonroad diesel engines that are retrofitted to achieve more stringent levels of emissions than are otherwise required to generate credits available for use in the ABT program by new nonroad engines. Credit-generating engines electing to participate in the program would be considered new nonroad diesel engines, subject to the normal compliance mechanisms applicable to other new nonroad diesel engines. These new nonroad engines could generate credits that could be used in the ABT program for other new nonroad diesel engines. Any such program would also have to ensure that credits are surplus, verifiable, quantifiable, and enforceable. We request comment on whether such a program would be feasible and appropriate for the Tier 4 nonroad standards, and on how such a program might be structured.

We are considering an approach for credit generation based on the use of advanced exhaust emission control technology/engine system combinations that would provide significant emissions reductions. To accomplish this, simple changes that are easy to circumvent accidentally or to defeat intentionally would not be eligible to generate credits, and essentially, only changes involving introduction of post combustion emissions control technology would be eligible. Thus, we would structure the program such that engine recalibration as the sole mechanism to reduce emissions would not be eligible for retrofit credits. Also, as noted, for purposes of a nonroad retrofit ABT program, in order to generate credits, the manufacturer of the nonroad retrofit engine system choosing to participate in the program would accept that the retrofit engine would be considered a new nonroad engine, subject to enforceable standards and normal certification and compliance requirements. We have outlined in a memorandum to the docket our ideas for meeting these objectives, including possible ways to structure the program.[299] This memorandum describes potential procedures for credit generation, credit use, and a number of compliance, implementation, and enforcement measures.

We recognize that expanding the ABT program in this way would introduce new issues and complexities to the nonroad Tier 4 program, and that there are several ways to structure the program. We are seeking comment on whether such an expansion of the ABT program is feasible and appropriate, as well as on the details of how a program could be structured. We have considered and described a possible framework for nonroad retrofit credits in an effort to help commenters provide input. The level of detail provided below and in the memorandum to the docket does not indicate that we have made any decisions on whether nonroad retrofit credits are appropriate for the ABT program or about how the program should function. We invite comment not only on the provisions described below and in the memorandum to the docket, but also on alternative approaches that commenters believe would lead to a better overall program.

We are also seeking comment on the timing of a retrofit credits approach. We believe that if such a program were adopted, credit generation could start in 2004 at the earliest, and request comment on ending the program in the 2015 time frame. We view this as primarily a transitional program which could be most useful in the early years of the nonroad program. Ending the program in 2015 may also ease concerns about long-term impact of such a program on the environment.

We encourage commenters to carefully address all aspects of a nonroad retrofit credits program including its usefulness, feasibility, compliance and enforcement measures, environmental benefits, and potential cost savings. We specifically request comment on the potential for such a program to provide additional emissions reductions than would otherwise be obtained and request comment on the potential impacts such provisions would have on emissions reductions associated with the proposed nonroad standards. We are also interested in comments on practical issues and details regarding how the program would operate and be enforced.

a. What would be the environmental impact of allowing ABT nonroad retrofit credits?

[299] Memorandum to the Docket, Chris Lieske and Joseph McDonald, EPA, Additional Information on Nonroad Retrofit Engine ABT Credit Concepts, Docket A–2001–28.

We would structure any nonroad credit ABT program in a way that provides greater overall emissions reductions over the life of the group of nonroad engines involved than would otherwise be achieved. These additional overall reductions would be achieved by applying a discount of 20 percent to ABT retrofit credits that are used to meet nonroad standards. The result of applying a discount would be that each ABT retrofit credit generated would translate to less than one nonroad engine credit available for consumption in the nonroad program. For example, a discount of 20 percent would reduce the consumable credits by 20 percent. The discount would provide greater overall net emissions reductions from the use of an ABT retrofit program, and the amount of this environmental benefit would increase with increased use of the program. Also, applying a discount would be consistent with past Agency actions (see additional discussion in the memorandum to the docket noted above).

A discount would be an essential element of the nonroad retrofit credit provisions, since one of our objectives if we promulgated such an expanded ABT program would be to create greater net emission reductions. The absence of a discount would result in no net environmental impact, as the generation of credits would lead to emissions reductions which would be offset by the increase in emissions when the credits were used. A discount would also serve to mitigate the potential for net environmental detriments due to uncertainties in credit calculation and use.

We request comment on whether a discount of 20 percent would be appropriate given the expectation that the discount will generate cost-effective emissions reductions that would otherwise not occur, as well as the more prevalent uncertainties associated with trading credits between nonroad retrofits and new nonroad engines.

b. How would EPA ensure compliance with retrofit emissions standards?

If this program were adopted, we would expect to require the retrofit manufacturer to specify all emissions related maintenance and to list the type of fuel used to certify its retrofit-engine system and whether a particular fuel sulfur level is necessary to meet the standard and to maintain emissions compliance of the retrofit-engine system in-use. If such a fuel is necessary to maintain emissions compliance in-use, EPA would also consider the fuel to be ‘‘critical emission related scheduled maintenance’’ under a retrofit engine program. As a result of such classification, the manufacturer would be required to demonstrate that proper fueling will be performed in-use. Such a demonstration would include a showing that the required fuel is available to, and would be used by, the ultimate consumer or fleet operator receiving the retrofitted engines. Such retrofitted engines would also have to be labeled appropriately to reflect the new engine family and may also require labeling for the type of fuel to be used. In general, we would require the manufacturer to submit a plan for implementing all relevant aspects of the retrofit to ensure proper installation and emissions compliance throughout the useful life period. A full discussion of compliance issues and possible compliance provisions, such as recall, in-use testing, useful life, and warranty is provided in the memorandum to the docket, noted above. We request comment on these approaches for ensuring in-use compliance with possible nonroad retrofit emissions standards and requirements.

c. What is the legal authority for a nonroad ABT retrofit program?

Allowing use by new nonroad engines of credits generated by retrofit of in-use nonroad engines is justified legally as an aspect of EPA's standard setting authority. As we envision a program, a retrofit nonroad engine would be considered to be a new nonroad engine when the manufacturer opts into a voluntary retrofit program (if established). Upon such opt-in, this new engine would be subject to enforceable standards under CAA section 213, somewhat similar to opting into the voluntary Blue Sky series standards (see Section VII.E.2). Thus, the generation of credits by nonroad retrofits and their use by new engines subject to Tier 4 would be similar to conventional ABT. Put another way, the generation of credits by retrofitting in-use non-road engines and their subsequent use by new nonroad engines subject to the Tier 4 standards is an averaging program involving emission credits generated by one type of new nonroad engine and used by other new nonroad engines, similar to conventional ABT programs. With a nonroad retrofit credit program, and the emissions reductions associated with it, the overall emission reductions from Tier 4 nonroad engines and nonroad retrofit engines, taken together, would be the greatest achievable considering cost, noise, safety and energy factors, and would also be appropriate after considering those same factors. See also *NRDC* v. *Thomas,* 805 F.2d 410, 425 (D.C. Cir. 1986) (averaging provisions upheld against challenge that they are inconsistent with NCP provisions), and *Husqvarna AB* v. *EPA*, 254 F.3d 195, 202 (D.C. Cir 2001) (averaging, banking, and trading provisions cited as an element supporting EPA's selection of lead time under section 213(b)). At the same time, we also note that the proposed standards are the greatest achievable (taking all statutory factors into account) and appropriate independent of the nonroad retrofit program, as explained elsewhere in this preamble.[300]

B. Transition Provisions for Equipment Manufacturers

1. Why Are We Proposing Transition Provisions for Equipment Manufacturers?

As EPA developed the 1998 Tier 2/3 standards for nonroad diesel engines, we determined that provisions were needed to avoid unnecessary hardship for equipment manufacturers. The specific concern is the amount of work required and the resulting time needed for equipment manufacturers to incorporate all of the necessary equipment redesigns into their applications in order to accommodate engines that have been redesigned to meet the new emission standards. We therefore adopted a set of provisions for equipment manufacturers to provide them with reasonable leadtime for the transition process to the newly adopted standards. The program consisted of four major elements: (1) A percent-of-production allowance, (2) a small-volume allowance, (3) availability of hardship relief, and (4) continuance of the allowance to use up existing inventories of engines. *See* 63 at FR 56977–56978 (Oct. 23, 1998).

Given the level of the proposed Tier 4 standards, we believe that there will be engine design changes comparable in magnitude to those involved during the transition to Tier 2/3. We thus believe that at least some equipment manufacturers will face comparable challenges during the transition to the Tier 4 standards. This is confirmed by comments to EPA by a number of the equipment Small Entity Representatives during the SBREFA process, which indicated that the Tier 2/3 transition provisions were proving beneficial in providing adequate leadtime and urging

[300] There is one minor exception to this analysis. Retrofits involving use of new nonroad engines as replacement engines in older nonroad equipment would be justified primarily as an aspect of EPA's lead time authority under section 213(d). This is because credits would not be generated from an engine certifying to a more stringent standard, so that the credit is effectively generated by equipment rather than by an engine, *i.e.* generated by something other than a new non-road engine.

EPA to adopt comparable provisions in a Tier 4 rule. *See* Report of the Small Business Advocacy Review Panel, section 8.4.1 (Dec. 23, 2002). Therefore, with a few exceptions described in more detail below, we are proposing to adopt transition provisions for Tier 4 in this notice that are similar to those adopted with the previous Tier 2/3 rulemaking. The following section describes the proposed transition provisions available to equipment manufacturers. (Section VII.C. of today's notice describes all of the proposed provisions that would be available specifically for small businesses.)

Our experience to date with the transition provisions for the Tier 2/3 standards above 50 horsepower is limited. In the one power category where manufacturers have been required to submit information on the number of engines using the allowances (engines between 300 and 600 horsepower), approximately 20 percent of the engines in the category are relying on the allowances in the first year that the Tier 2 standards apply. (For the power categories below 50 horsepower, manufacturers are reporting that there are very few engines using allowances. However, given the level of the Tier 1 standards, we would not expect there to have been much need for equipment redesign to handle Tier 1 engines.) While this information is useful, we do not believe there is enough information available to determine if the level of the existing allowances should be revised for the Tier 4 proposal. For this reason, we are primarily relying on the provisions of the Tier 2/3 equipment manufacturer transition provisions for the Tier 4 proposal. However, as described in more detail below, we are proposing to add notification, reporting, and labeling requirements to the Tier 4 proposal, which are not required in the existing transition provisions for equipment manufacturers. We believe these additional proposed provisions are necessary for EPA to gain a better understanding of the extent to which these provisions will be used and to ensure compliance with the Tier 4 transition provisions. We are also proposing new provisions dealing specifically with foreign equipment manufacturers and the special concerns raised by the use of the transition provisions for equipment imported into the U.S.

As under the existing provisions, equipment manufacturers would not be obligated to use any of these provisions, but all equipment manufacturers would be eligible to do so. Also, as under the existing program, we are proposing that all entities under the control of a common entity, and that meet the definition in the regulations of a nonroad vehicle or nonroad equipment manufacturer contained in the regulations, would have to be considered together for the purposes of applying exemption allowances. This would not only provide certain benefits for the purpose of pooling exemptions, but would also preclude the abuse of the small-volume allowances that would exist if companies could treat each operating unit as a separate equipment manufacturer.

2. What Transition Provisions Are We Proposing for Equipment Manufacturers?

a. Percent-of-Production Allowance

Under the proposed percent-of-production allowance, each equipment manufacturer may install engines not certified to the proposed Tier 4 emission standards in a limited percentage of machines produced for the U.S. market. Equipment manufacturers would need to provide written assurance to the engine manufacturer that such engines are being procured for the purpose of the transition provisions for equipment manufacturers. These engines would instead have to be certified to the standards that would apply in the absence of the Tier 4 standards (*i.e.*, Tier 2 for engines below 50 horsepower, Tier 3 for engines between 50 and 750 horsepower,[301] and Tier 2 for engines above 750 horsepower). This percentage would apply separately to each of the proposed Tier 4 power categories (engines below 25 horsepower, engines between 25 and 75 horsepower, engines between 75 and 175 horsepower, engines between 175 and 750 horsepower, and engines above 750 horsepower) and is expressed as a cumulative percentage of 80 percent over the seven years beginning when the Tier 4 standards first apply in a category. No exemptions would be allowed after the seventh year. For example, an equipment manufacturer could install engines certified to the Tier 3 standards in 40 percent of its entire 2011 production of nonroad equipment that use engines rated between 175 and 750 horsepower, 30 percent of its entire 2012 production in this horsepower category, and 10 percent of its entire 2013 production in this horsepower category. (During the transitional period for the Tier 4 standards, the fifty percent of engines that would be allowed to certify to the previous tier NO_X standard but meet the Tier 4 PM standard would be considered as Tier 4-compliant engines for the purpose of the equipment manufacturer transition provisions.) If the same manufacturer were to produce equipment using engines rated above 750 horsepower, a separate cumulative percentage allowance of 80 percent would apply to these machines during the seven years beginning in 2011. This proposed percent-of-production allowance is almost identical to the percent-of-production allowance adopted in the October 1998 final rule, the difference being, as explained earlier, that we are proposing to have fewer power categories associated with the proposed Tier 4 standards.

The proposed 80 percent exemption allowance, were it to be used to its maximum extent by all equipment manufacturers, would bring about the introduction of cleaner engines several months later than would have occurred if the new standards were to be implemented on their effective dates. However, the equipment manufacturer flexibility program has been integrated with the standard-setting process from the initial development of this proposal, and as such we believe it is a key factor in assuring that there is sufficient lead time to initiate the Tier 4 standards according to the proposed schedule.[302]

Machines that use engines built before the effective date of the proposed Tier 4 standards would not be included in an equipment manufacturer's percent of production calculations under this allowance. Machines that use engines certified to the previous tier of standards under our Small Business provisions (as described in Section VII.C. of this proposal) would not be included in an equipment manufacturer's percent of production calculations under this allowance. All engines certified to the Tier 4 standards, including those engines that produce emissions at higher levels than the

[301] Under this proposal, for engines between 50 and 75 horsepower, the $NMHC+NO_X$ standard that would apply in Tier 4 is the same as the existing Tier 3 $NMHC+NO_X$ standard.

[302] For emissions modeling purposes, we have assumed that manufacturers take full advantage of the existing allowances under the transition program for equipment manufacturers in establishing the emissions baseline. This assumption is based on information provided to us by engine manufacturers for model year 2001, which shows that approximately 20 percent of the engines in the 300–600 horsepower category are relying on the allowances in the first year that the Tier 2 standards apply. In modeling the Tier 4 program, because the program will not take effect for many years and it is not possible to accurately forecast use of the proposed transition program for equipment manufacturers and to assess costs in a conservative manner, we have assumed that all engines will meet the Tier 4 standards in the timeframe proposed. As discussed in section V.C., this is consistent with our cost analysis, which assumes no use of the proposed transition program for equipment manufacturers.

standards, but for which an engine manufacturer uses ABT credits to demonstrate compliance, would count as Tier 4 complying engines and would not be included in an equipment manufacturer's percent of production calculations. As noted earlier, engines that meet the proposed Tier 4 PM standards but are allowed to meet the Tier 3 $NMHC+NO_X$ standards during the phase-in period would also count as Tier 4 complying engines and would not be included in an equipment manufacturer's percent of production calculations. And, as also noted earlier, all engines used under the percent-of-production allowance would have to certify to the standards that would be in effect in the absence of the Tier 4 standards (*i.e.*, the Tier 3 standards for engines between 50 and 750 horsepower and the Tier 2 standards for engines below 50 horsepower and above 750 horsepower).

The choice of a cumulative percent allowance of 80 percent is based on our best estimate of the degree of reasonable leadtime needed by equipment manufacturers. We believe the 80 percent allowance responds to the need for flexibility identified by equipment manufacturers, while ensuring a significant level of emission reductions in the early years of the proposed program.

We are also proposing to allow manufacturers to start using a limited number of the new Tier 4 flexibilities once the seven-year period for the existing Tier 2/Tier 3 program expires (and so continue producing engines meeting Tier 1 or Tier 2 standards). In this way, a manufacturer could potentially continue exempting the most difficult applications once the seven-year period of the current Tier 2/3 flexibility provisions is finished. (Under the existing transition program for equipment manufacturers, any unused allowances expire after the seven year period. We are not reopening this provision with this proposal.) However, opting to start using Tier 4 allowances once the seven-year period from the current Tier 2/Tier 3 program expires would reduce the available percent of production exemptions available from the Tier 4 standards. We are proposing that equipment manufacturers may use up to a total of 10 percent of their Tier 4 allowances prior to the effective date of the proposed Tier 4 standards. (The early use of Tier 4 allowances would be allowed in each Tier 4 power category.) This percentage of equipment utilizing the early Tier 4 allowances would be subtracted from the proposed Tier 4 allowance of 80 percent for the appropriate power category, resulting in fewer allowances once the Tier 4 standards take effect. For example, if an equipment manufacturer used the maximum amount of early Tier 4 allowances of 10 percent, then the manufacturer would have a cumulative total of 70 percent remaining when the Tier 4 standards take effect (*i.e.*, 80 percent production allowance minus 10 percent). We are also requesting comment on requiring equipment manufacturers to take a two-for-one loss of Tier 4 allowances for each allowance used prior to the Tier 4 effective date. This would reduce the number of overall engines that could be exempted under the Tier 4 allowance program and result in greater environmental benefits than would be realized if manufacturers used all of the Tier 4 allowances in the Tier 4 timeframe.

We view this proposed provision on early use of Tier 4 allowances as providing reasonable leadtime for introducing Tier 4 engines, since it should result in earlier introduction of Tier 4-compliant engines (assuming that the 80% allowance would otherwise be utilized) with resulting net environmental benefit (notwithstanding longer utilization of earlier Tier engines, due to the stringency of the Tier 4 standards) and should do so at net reduction in cost by providing cost savings for the engines that have used the Tier 4 allowances early. As discussed above, once the Tier 4 implementation model year begins, engines which use the transition provision allowances must be certified to the standards that would apply in the absence of the Tier 4 standards.

b. Small-Volume Allowance

The percent-of-production approach described above may provide little benefit to businesses focused on a small number of equipment models. Therefore we are proposing to allow any equipment manufacturer to exceed the percent-of-production allowances described above during the same seven year period, provided the manufacturer limits the number of exempted engines to 700 total over the seven years, and to 200 in any one year. As noted earlier, equipment manufacturers would need to provided written assurance to the engine manufacturer when it purchases engines under the transition provisions for equipment manufacturers. The limit of 700 exempted engines would apply separately to each of the proposed Tier 4 power categories (engines below 25 horsepower, engine between 25 and 75 horsepower, engines between 75 and 175 horsepower, engines between 175 and 750 horsepower, and engines above 750 horsepower). In addition, manufacturers making use of this provision must limit exempted engines to a single engine family in each Tier 4 power category.

As with the proposed percent-of-production allowance, machines that use engines built before the effective date of the proposed Tier 4 standards would not be included in an equipment manufacturer's count of engines under the small-volume allowance. Similarly, machines that use engines certified to the previous tier of standards under our Small Business provisions (as described in Section VII.C. of this proposal) would not be included in an equipment manufacturer's count of engines under the small-volume allowance. All engines certified to the Tier 4 standards, including those that produce emissions at higher levels than the standards but for which an engine manufacturer uses ABT credits to demonstrate compliance, would be considered as Tier 4 complying engines and would not be included in an equipment manufacturer's count of engines under the small-volume allowance. Engines that meet the proposed Tier 4 PM standards but are allowed to meet the Tier 3 $NMHC+NO_X$ standards during the phase-in period would also be considered as Tier 4 complying engines and would not be included in an equipment manufacturer's count of engines under the small-volume allowance. All engines used under the small-volume allowance would have to certify to the standards that would be in effect in the absence of the Tier 4 standards (*i.e.*, the Tier 3 standards for engines between 50 and 750 horsepower and the Tier 2 standards for engines below 50 horsepower and above 750 horsepower).

In discussions regarding the current small-volume allowance, some manufacturers expressed the desire to be able to exempt engines from more than one engine family, but still fall under the number of exempted engine limit. (Under the current rules, although equipment manufacturers are allowed to exempt up to 700 units over seven years, they must all use the same engine family. In many cases, a manufacturer's largest sales volume model does not even sell 700 units over seven years. As a result, the maximum number of units a manufacturer can exempt under the small-volume allowance is less than the 700 unit limit.) We are concerned, however, that allowing manufacturers to exempt engines in more than one family, but retaining the current 700-unit allowance, could lead to significantly higher numbers of engines being exempted from the Tier 4 program.

Using data of equipment sales by equipment manufacturers that qualify as small businesses under Small Business Administration (SBA) guidelines, we have analyzed the effects of a small-volume allowance program that would set an exempted engine allowance lower than 700 units over seven years but allow manufacturers to exempt engines from more than one engine family. Based on sales information for small businesses, we believe we could revise the small-volume allowance program to include lower caps and allow manufacturers to exempt more than one engine family while still keeping the total number of engines eligible for the allowance at roughly the same overall level as the 700-unit program described above.[303] Such a program would in general provide sufficient leadtime for equipment manufacturers, allowing them to temporarily exempt greater numbers of equipment models from the proposed Tier 4 standards, but, as noted above, keeping the total number of engines eligible for the allowance at roughly the same overall level as the existing program would allow (and so not allow more leadtime than necessary). Based on our analysis, the small-volume allowance program could be revised to allow equipment manufacturers to exempt 525 machines over seven years (with a maximum of 150 in any given year) for each of the three power categories below 175 horsepower, and 350 machines over seven years (with a maximum of 100 in any given year) for the two power categories above 175 horsepower. Concurrent with the revised caps, manufacturers would be allowed to exempt engines from more than one engine family under the small-volume allowance program. Table VII.B–1 compares the proposed small-volume allowance program to the variation described in this paragraph.

TABLE VII.B–1.—SMALL-VOLUME ALLOWANCE PROGRAM COMPARISON

	Engines exempted over 7 years	Maximum exempted engines in one year	Single engine family restriction?
Proposed program	—700 for each power category	200	—Yes
Variation under consideration	—525 for power categories < 175 hp —350 for power categories > 175 hp	100	—No

We request comment on adopting a small-volume allowance program with the lower caps noted above that allows manufacturers to exempt more than one engine family in each power category. We specifically request comment on allowing equipment manufacturers to choose between the two small-volume allowance programs described above. Alternatively, we request comment on whether we should replace the current program (which allows 700 units over seven years with a one engine family restriction) with this revised small-volume allowance program (which would allow fewer units over seven years but without the single engine family restriction). Our analysis of small businesses noted above did show that there were a very limited number of companies that could potentially get fewer total allowances under a revised program with the lower caps compared to the existing program (i.e., a company that sells an equipment model that utilizes one engine family whose sales over a seven year period are above the revised limits noted above but less than 700). Allowing an equipment manufacturer to choose between the two programs would help to ensure that manufacturers are able to retain the current level of flexibility they have under the current program.

Because we are proposing fewer power categories for the Tier 4 standards, the proposed equipment flexibility program is designed to reflect those changes. Therefore, under the proposed small-volume allowance, the specified unit allowances will apply separately to each of the five power categories being proposed for the Tier 4 standards.

As noted earlier, we are also proposing to allow manufacturers to start using a limited number of the new Tier 4 flexibilities once the seven-year period for the existing Tier 2/Tier 3 program expires (and so continue producing engines meeting Tier 1 or Tier 2 standards). Under the proposed small-volume allowance, any engines used by the manufacturer prior to Tier 4 would be subtracted from the proposed 700 unit allowance (for the appropriate Tier 4 power category), resulting in fewer allowances once the Tier 4 standards take effect. As with the proposed percent-of-production allowance, we are proposing to limit the number of Tier 4 small-volume allowances that can be used prior to the effective dates of the Tier 4 standards to a total of 100 units in each of the Tier 4 power categories. We are taking comment on requiring equipment manufacturers to take a two-for-one loss of Tier 4 small-volume allowances for each allowance used prior to the Tier 4 effective date. As explained above, we view this proposal as providing reasonable leadtime for introduction of Tier 4 engines by providing the possibility of earlier introduction of such engines with a net cost savings.

c. Hardship Relief Provision

We are proposing to extend the availability of the ''hardship relief provision'' with the Tier 4 transition provisions for equipment manufacturers. Under the proposal, an equipment manufacturer that does not make its own engines could obtain limited additional relief by providing evidence that, despite its best efforts, it cannot meet the implementation dates, even with the proposed equipment flexibility program provisions outlined above. Such a situation might occur if an engine supplier without a major business interest in the equipment manufacturer were to change or drop an engine model very late in the implementation process. As with other equipment manufacturer transition provisions, the equipment Small Entity Representatives indicated that the availability this allowance was useful to them in the transition to the Tier 2/3 standards, and they urged that it be continued in any Tier 4 rule. Report of the Small Business Advocacy Panel, section 8.4.1.

[303] ''Analysis of Small Volume Equipment Manufacturer Flexibilities,'' EPA memo from Phil Carlson to Docket A–2001–28.

Applications for hardship relief would have to be made in writing, and would need to be submitted before the earliest date of noncompliance. The application would also have to include evidence that failure to comply was not the fault of the equipment manufacturer (such as a supply contract broken by the engine supplier), and would need to include evidence that serious economic hardship to the company would result if relief is not granted. We would work with the applicant to ensure that all other remedies available under the flexibility provisions were exhausted before granting additional relief, if appropriate, and would limit the period of relief to no more than one year. Applications for hardship relief generally will only be accepted during the first year after the effective date of an applicable new emission standard.

The Agency expects this provision would be rarely used. This expectation has been supported by our initial experience with the Tier 2 standards in which only one equipment manufacturer has applied under the hardship relief provisions. Requests for hardship relief would be evaluated by EPA on a case-by-case basis, and may require, as a condition of granting the applications, that the equipment manufacturer agree (in writing) to some appropriate measure to recover the lost environmental benefit.

d. Existing Inventory Allowance

The current program for nonroad diesel engines includes a provision for equipment manufacturers to continue to use engines built prior to the effective date of new standards, until the older engine inventories are depleted. It also prohibits stockpiling of previous tier engines. We are proposing to extend these provisions as manufacturers transition to the standards contained in this proposal. We are also proposing to extend the existing provision that provides an exception to the applicable compliance regulations for the sale of replacement engines. In proposing to extend this provision, we are requiring that engines built to replace certified engines be identical in all material respects to an engine of a previously certified configuration that is of the same or later model year as the engine being replaced. The term ''identical in all material respects'' would allow for minor differences that would not reasonably be expected to affect emissions.

3. What Are the Recordkeeping, Notification, Reporting, and Labeling Requirements Associated With the Equipment Manufacturer Transition Provisions?

a. Recordkeeping Requirements for Engine and Equipment Manufacturers

We are proposing to extend the recordkeeping requirements from the current equipment manufacturer transition program. Under the proposed requirements, engine manufacturers would be allowed to continue to build and sell previous tier engines needed to meet the market demand created by the equipment manufacturer flexibility program, provided they receive written assurance from the engine purchasers that such engines are being procured for this purpose. We are proposing that engine manufacturers would be required to keep copies of the written assurance from the engine purchasers for at least five full years after the final year in which allowances are available for each power category.

Equipment manufacturers choosing to take advantage of the proposed Tier 4 allowances would be required to: (1) Keep records of the production of all pieces of equipment excepted under the allowance provisions for at least five full years after the final year in which allowances are available for each power category; (2) include in such records the serial and model numbers and dates of production of equipment and installed engines, and the rated power of each engine, (3) calculate annually the number and percentage of equipment made under these transition provisions to verify compliance that the allowances have not been exceeded in each power category; and (4) make these records available to EPA upon request.

b. Notification Requirements for Equipment Manufacturers

We are also proposing some new notification requirements for equipment manufacturers with the Tier 4 program. Under this proposal, equipment manufacturers wishing to participate in the Tier 4 transition provisions would be required to notify EPA prior to their use of the Tier 4 transition provisions. Equipment manufacturers would be required to submit their notification before the first calendar year in which they intend to use the transition provisions. We believe that prior notification will not be a significant burden to the equipment manufacturer, but will greatly enhance our ability to ensure compliance. Indeed, EPA believes that in order for an equipment manufacturer to properly use either of the allowances provided, it would already have the information required in the notification. Thus we are not requiring additional planning or information gathering beyond that which the equipment manufacturer must already be doing in order to ensure its compliance with the regulations. Under the proposed notification requirements, each equipment manufacturer would be required to notify EPA in writing and provide the following information:

(1) The nonroad equipment manufacturer's name, address, and contact person's name, phone number;

(2) the allowance program that the nonroad equipment manufacturer intends to use by power category;

(3) the calendar years in which the nonroad equipment manufacturer intends to use the exception;

(4) an estimation of the number of engines to be exempted under the transition provisions by power category;

(5) the name and address of the engine manufacturer from whom the equipment manufacturer intends to obtain exempted engines; and

(6) identification of the equipment manufacturer's prior use of Tier 2/3 transition provisions.

EPA is requesting comment on whether the notification provisions should also apply to the current Tier 2/ Tier 3 transition program, and if so, how these provisions should be phased in for equipment manufacturers using the current Tier 2/Tier 3 transition provisions. EPA believes such a notification provision could be implemented as soon as 2005 and requests comments on the appropriate start date should we adopt such a notification provision for equipment manufacturers for the Tier 2/Tier 3 transition program.

c. Reporting Requirements for Engine and Equipment Manufacturers

As with the current program, engine manufacturers who participate in the proposed Tier 4 program would be required to annually submit information on the number of such engines produced and to whom the engines are provided, in order to help us monitor compliance with the program and prevent abuse of the program.

We are proposing new reporting requirement for equipment manufacturers participating in the Tier 4 equipment manufacturer transition provisions. Under this proposal, equipment manufacturers participating in the program would be required to submit an annual written report to EPA that calculates its annual number of exempted engines under the transition provisions by power category in the